TESTING SEMICONDUCTORS MADE EASY

www.gernsback.com

NOVEMBER 1999

Electronics NOW®

Was that a truck passing by, or did the Earth just move under your feet? You'll know if you build the

Seismic Detector

Build A Frequency Probe

It's the quick and easy way to test the frequency of any circuit

Audio Gets Easier

Learn how to use National's new "Boomer" audio-amplifier ICs

A Rotary Encoder

Makes measuring the position of any rotary shaft a snap

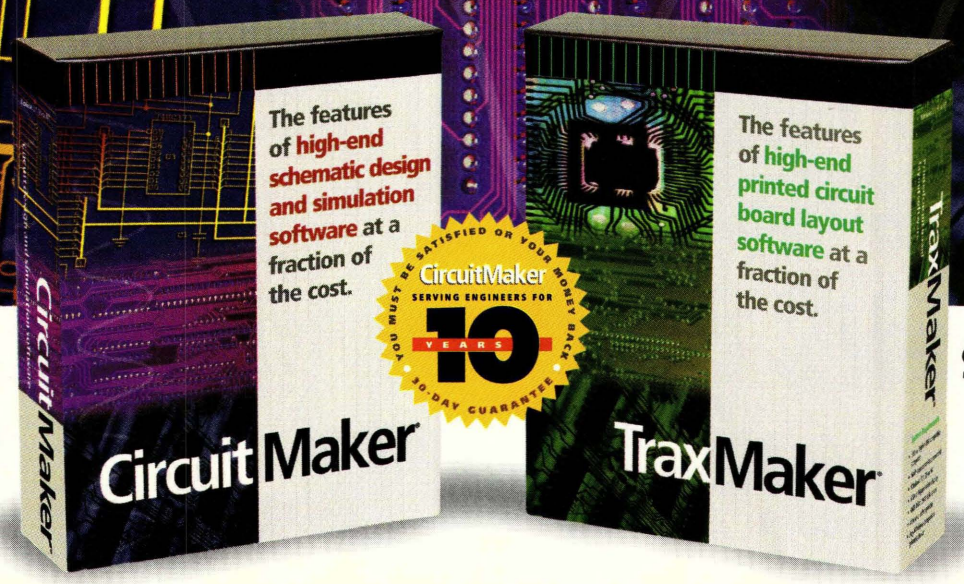
$4.99 U.S.
$5.99 CAN.

#BXNBQWF****** 5-DIGIT 54303
#LRIO424WO98 2#751768 OAP27
MAY OO

JOE LORITZ
424 WILSON AVE O3EN
GREEN BAY WI 54303-4115

A GERNSBACK PUBLICATION

High-end features. Low-end price.


The features of high-end schematic design and simulation software at a fraction of the cost.
CircuitMaker
The features of high-end printed circuit board layout software at a fraction of the cost.
TraxMaker
CircuitMaker
SERVING ENGINEERS FOR 10 YEARS
YOU MUST BE SATISFIED OR YOUR MONEY BACK
30-DAY GUARANTEE

$299
CircuitMaker 6:
Schematic design and simulation software

$299
TraxMaker 3 :
Printed circuit board layout software

CircuitMaker Version 6 and TraxMaker Version 3 give you the features of professional, high-end software at a fraction of the cost. Plus, with exceptional ease-of-use, you'll spend less time learning touse the software and more time designing. Both applications are compatible with your existing design software, and feature outstanding technical support. Call now for your free functional demo.

CircuitMaker 6 is a powerful schematic design and simulation program featuring:

- *Professional schematic features including printout borders, title block and barred pin names*
- *Symbol editor and Macro feature for custom devices*
- *Fast, accurate SPICE3f5/XSPICE-based simulation*
- *Complete array of analysis types, including Fourier, AC, DC Parameter Sweep, Transient and more*
- *Virtual instruments including a digital oscilloscope, multimeter, Bode plotter, curve tracer and more*
- *Extensive library of over 4,000 devices*
- *Tight integration with TraxMaker® for quick PCB layout*
- *Output PCB netlists in Protel®, Tango®, and TraxMaker®, formats for use in a variety of PCB layout programs*
- *Windows 3.1, 95, 98 and NT*

TraxMaker 3 is a powerful printed circuit board layout program featuring:

- *Over 2,000 component footprints in a fully-documented, indexed library. Documentation shows footprints actual size*
- *Built-in autorouter and Design Rules Check*
- *Supports up to 6 signal layers plus power and ground planes, silk screen overlays and solder and paste masks*
- *Board sizes up to 32"x 32", with no pin limitations*
- *Intelligent manual routing with unroute capabilities*
- *Import any PCB netlist in CircuitMaker®, Protel® or Tango® format*
- *Output RS274X Gerber files, Excellon N/C drill files and Bill of materials*
- *Print to any Windows compatible printer or plotter*
- *Windows 3.1, 95, 98 and NT*

CircuitMaker
CUSTOMER SERVICE CENTER

For free demo software, or to order, call 1-800-419-4242

5252 N. Edgewood Dr #175 • Provo, UT 84604 • Tel 801.224.0433 • Fax 801.224.0545 • **www.microcode.com**

©1999 Protel International Pty Ltd. All rights reserved. CircuitMaker, TraxMaker and SimCode are registered trademarks of Protel International Pty Ltd. All other brand and product names are trademarks or registered trademarks of their respective companies.

CIRCLE 133 ON FREE INFORMATION CARD

Electronics NOW
Combined with Radio Electronics

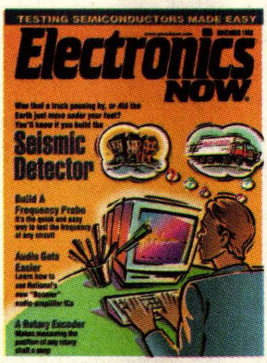
Vol. 70 No 11

CONTENTS

NOVEMBER 1999

ON THE COVER

33 A Seismic Detector



Recent events in Turkey and elsewhere around the world have once again shown us that the solid Earth is not nearly as solid as we often assume. If in light of such things you want to keep a closer eye on the ground under your feet, or if you want to investigate earthquakes and similar natural phenomena, then you'll want to build this month's cover project. It is a computer-based seismic detector that's great in the lab, and—since it is battery powered and portable—even better in the field. — *Ron Newton*

BUILD THIS

43 Precision Audio Dummy Load
Test audio amps without using speakers. — *Gary McClellan*

47 Infrared-Based Rotary Encoder
This simple circuit lets you accurately measure the position of any rotary shaft. — *James J. Barbarello*

87 Frequency Probe
A quick and easy way to measure frequency of any waveform up to 2 MHz. — *Skip Campisi*

TECHNOLOGY

13 Prototype
Blood tests without needle sticks, super-small IC masks, verifying extraterrestrial contacts, safer train crossings, and more.

39 Audio Gets Easier: Using the New LM4862
National Semiconductors' new "Boomer" audio-amplifier ICs are an audio hobbyist's dream come true; here's how to use one of them. — *Michael A. Covington*

DEPARTMENTS

4 Equipment Report
Olympus C-2000 Zoom Digital Camera.

8 Service Clinic
The easy way to test semiconductors. — *Sam Goldwasser*

24 DX Listening
Weird antennas of yesteryear. — *Don Jensen*

20 Antique Radio
Troubleshooting a dead receiver. — *Marc Ellis*

27 Computer Connections
Really bad computer "deals." — *Konstantinos Karagiannis*

90 Tech Musings
Sub-pixel secrets, diodes as RF switches, and more. — *Don Lancaster*

AND MORE

2 Letters
5 Q&A
29 New Products
95 New Literature
98 Advertising Index
98 Advertising Sales Office

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques, and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 1067-9294) November 1999. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions $24.99, Canada $33.15 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries $33.99. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies $4.99. © 1999 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

Upgrade Update

As author of the article "Controlling Servos From a Computer" (**Electronics Now**, August 1999), I would like to update the article and make a correction.

The correction concerns my e-mail address; it is listed incorrectly in the Part List box. The correct address is rmoro @compuserve.com—note that the first letter was omitted.

The manufacturer of IC1 has upgraded the chip, requiring an update to the software. That software is now on the Gernsback FTP site under the same name (ftp.gernsback.com/pub/EN/itc232.txt). If you are having difficulty with your project, re-download the updated software.

RICARDO MORO-VIDAL

An April Fool Revisited

I read the letter in the August 1999 "Letters" column on the April Fool's article and was reminded of an experience of many years ago. As a young man, say 15, I was reading a then old copy of ***Popular Electronics*** (April) and was truly inspired with an article on "Contra-Polar Energy," which detailed a circuit that would reverse the physical properties of common electrical devices. It was accompanied by a photo of an ice tray filled with ice and sitting on a hot plate, plus various other awe-inspiring photos.

Seeing great potential in this, I promptly wrote a letter to the editors requesting more information. (I am sure that this caused great hilarity when read.) They then sent me a reply explaining the relationship of the article and the issue date, Boy, was my face red upon receiving this much anticipated reply. I still remember the event clearly after some 37 years or so!

Keep up the humor; after all this time when reminded of that event I get a big smile and that tickle of humor down my back.

RICK LANE
Los Lunas, NM

Two-Cents Worth of Soldering Tips

Skip Campisi has authored the best instructions for hand soldering that I have ever seen in his article "How to Succeed In Soldering" (**Electronics Now**, July 1999). However, as an EE and an electronic hobbyist for over 40 years, I would like to add my two-cents worth. First, when working with electrostatic-sensitive semiconductors (as most ICs today are), you must use an iron with a grounded tip. That is why many technicians use a soldering station—they are almost always grounded. I don't know why, but individual pencil irons with a three-wire cord and a grounded tip are hard to find.

An old, old method for keeping an iron from overheating is to rig a circuit with an ordinary light bulb in series with the soldering iron along with a switch that shorts out the lamp. This keeps the iron cool enough to reduce tip oxidation, but still maintains an adequate soldering temperature. The lamp is switched out when heating the iron from a cold start and also whenever extra heat is needed. Standard 120-volt, 25-watt, or 40-watt lamps work well, depending on the wattage of the iron.

Any components that have been lying around in a junk box for a few years are likely to have oxidized leads. Resistor leads seem to be especially vulnerable. Cleaning such leads with a fiberglass brush or a small piece of extra-fine steel wool will reduce the incidence of cold solder joints. Keep up the good work.

MARTEN JENSEN
Redlands, CA

EN

Write To:
Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

Electronics Now Combined with Radio Electronics® NOW®

Hugo Gernsback (1884-1967) founder

LARRY STECKLER, EHF, CET, Editor-in-chief and publisher
ADRIA COREN, Vice President
KEN COREN, Vice President

EDITORIAL DEPARTMENT
CARL LARON, editor
JOSEPH J. SUDA, technical editor
EVELYN ROSE, assistant editor
MICHAEL A. COVINGTON, N4TMI contributing editor
MARC ELLIS, contributing editor
SAM GOLDWASSER, service editor
DON JENSEN, contributing editor
KONSTANTINOS KARAGIANNIS, computer editor
FRANKLIN J. MILLER, audio editor
DON LANCASTER, contributing editor
JANINE ABITABILE, editorial assistant

ART DEPARTMENT
ANDRE DUZANT, art director
RUSSELL C. TRUELSON, illustrator

PRODUCTION DEPARTMENT
KEN COREN production director
KATHRYN R. CAMPBELL production manager
MICHELE MUSÉ prepress specialist

CIRCULATION DEPARTMENT
GINA GALLO circulation director
CHRISTINA M. ESTRADA circulation assistant

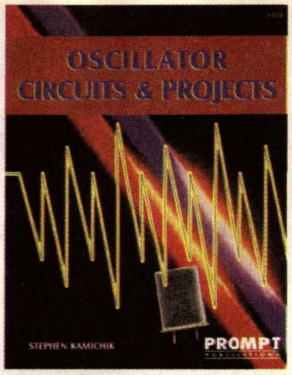
REPRINT DEPARTMENT
JANINE ABITABILE reprint bookstore

Electronics Now is indexed in *Applied Science & Technology Index, Readers Guide to Periodical Literature, Academic Abstracts*, and *Magazine Article Summaries.*
Microfilm & Microfiche editions are available. Contact reprint bookstore for details.

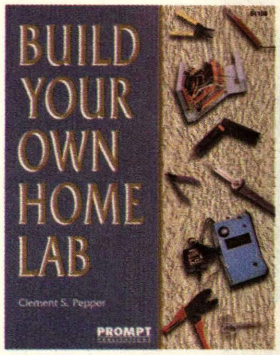
Advertising Sales Offices listed on page 98.
Electronics Now Executive and Administrative Offices
1-516-293-3000.
Subscriber Customer Service:
1-800-288-0652.
Order Entry for New Subscribers:
1-800-999-7139.

VISIT US ON THE INTERNET AT
www.gernsback.com

☐ **Test Procedures for Basic Electronics. #61063. -- $19.95**
Many useful tests and measurements are covered. They are reinforced by the appropriate basic principles. Examples of test and measurement setups are given to make concepts more practical. *7 3/8 x 9/1/4", 356 pp, paperback.*

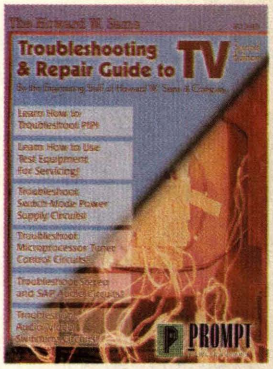


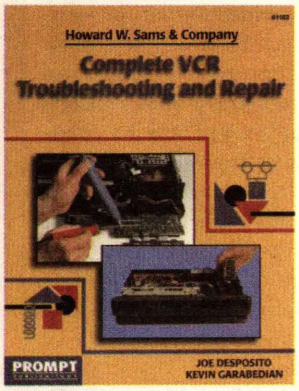
☐ **Oscillator Circuits and Projects. #61111. -- $24.95**
A Textbook and project book for those who want to know more about oscillator circuits. You can build and enjoy the informative and entertaining projects detailed in this book. Complete information is presented in an easy-to-follow manner. *7 3/8 x 9 1/4", 249 pp, paperback.*



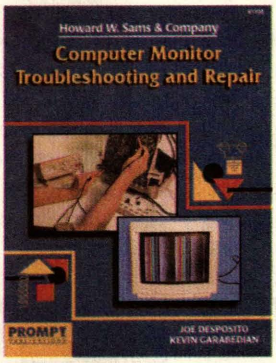
☐ **Build Your Own Home Lab. #61108 -- $29.95**
Shows you how to assemble an efficient working home lab, and how to make it pay its own way. Includes projects for creating your own test instruments too. *7 3/8 x 9 1/4", 249 pp, paperback.*

☐ **Troubleshooting and Repair Guide to TV. #62246. -- $34.95**
Repairing and troubleshooting a TV is very simple and economical with help from the information in this book. It is the most complete and up-to-date TV repair book available, with tips on how to handle the newest circuits. *8 1/2 x 11", 263 pp, paperback.*

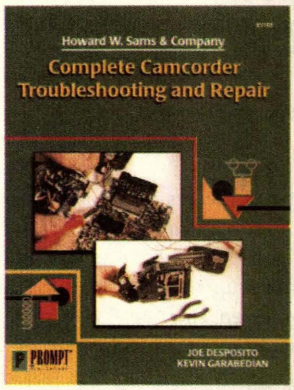




☐ **Complete VCR Troubleshooting and Repair. #61102. -- $34.95**
Though VCRs are complex, you don't need complex tools or test equipment to repair them. This book contains sound troubleshooting procedures that guide you through every task. *8 1/2 x 11", 184 pp, paperback.*

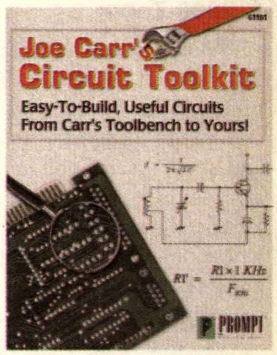


☐ **Computer Monitor Troubleshooting and Repair. #61100. -- $34.95**
This book can save you the money and hassle of computer monitor repair by showing you how to fix it yourself. Tools, test instruments, how to find and solve problems are all detailed. *8 1/2 x 11", 308 pp, paperback.*



☐ **Complete Camcorder Troubleshooting and Repair. #61105. -- $34.95**
Learn everything you need to know about the upkeep and repair of video camcorders. Start by examining camcorder troubleshooting procedures, then move into more advanced repair techniques. *8 1/2 x 11", 208 pp, paperback*

☐ **Joe Carr's Circuit Toolkit. #61000. -- $29.95**
Easy-to-build, useful circuits from Carr's workbench to you. They will spark new ideas in your day-to-day use of circuits and help solve frustrating problems. *256 pp, paperback.*



Please circle the products you would like to buy on the page above, calculate the total cost, include shipping charges, using in the form below and send it to us. Please allow 4 - 6 weeks for standard delivery.

Name:_____

Address:_____

_____

Zip: _____ Telephone:_____

I have enclosed my check for $: _____

Signature:_____

Please charge my credit card for $: _____ Number: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Card Type:_____ Expiration Date: ☐☐ ☐☐ ☐☐

Mastercard, Visa or Discover only

Note: The delivery address and the address at which the credit card is registered must be the same.

Claggk Inc.
PO Box 4099
Farmingdale, NY 11735-0792
Tel: 516-293-3751
Fax: 516-293-3115
email: claggk@gernsback.com

SHIPPING CHARGES IN USA. CANADA ADD $5.00

1 Book	$ 5.00
2 Books	8.00
each add'l book	3.00
2 Day UPS	$10.00 extra
Next Day UPS	$20.00 extra

SORRY No orders accepted outside of USA & Canada **No. of Books Ordered** ☐

Total price of books.....$.....
Shipping (see chart).....$.....
Subtotal.....$.....
Sales Tax (NYS only).....$.....
Amount Enclosed.....$.....

All payments must be in U.S. funds! CL04

EQUIPMENT REPORT

OLYMPUS C-2000 ZOOM DIGITAL CAMERA

Digital images swell to 2.1 megapixels with Olympus' new C-2000 Zoom digital camera. Pair it with their P-330 printer for a complete digital-photography solution.

CIRCLE 15 ON FREE INFORMATION CARD

Digital cameras have become good substitutes for traditional film-based cameras because they are now affordable and their image quality is good enough to compete with 35mm film. Well, the good news just keeps getting better as the latest digital camera from Olympus, the C-2000 Zoom, raises the bar for image quality and features set in consumer-priced digital cameras.

C-2000 Zoom

When it needs to be, the Olympus C-2000 Zoom is easy to use. The aluminum-body camera has a completely automatic "program" mode for point-and-shoot users, plus aperture-priority and shutter-priority modes for more advanced users. "Aperture priority" is where the user chooses the best aperture and the camera sets the shutter speed, and "shutter priority" is where the user selects a shutter speed and the camera sets the aperture. Aperture priority allows greater control over depth of field, while shutter priority lets the user select the best shutter speed. Sporting events, for example, generally require fast shutter speeds to capture motion without blurriness. On the other hand, blurriness is sometimes desired, and shutter priority would allow that. Shutter speeds range from fi to 1/800 second.

The C-2000 Zoom digital camera features a 2.1-megapixel CCD that produces images with a maximum resolution of 1600 × 1200. The standard image format is JPEG, with different image sizes and levels of compression available. The C-2000 Zoom can save standard quality (SQ), high-compression JPEG images in 640 × 480 and 1024 × 768 sizes. It can also save high quality (HQ), medium-compression images, or super-high-quality (SHQ), low-compression images, with a size of 1600 × 1200 pixels. The C-2000 Zoom also has a zero-compression, zero-loss TIFF mode for 1600 × 1200 images. Built-in high-speed DRAM provides buffering and allows for sequence shooting of 5 to 45 images in half-second intervals.

The C-2000 Zoom stores images on SmartMedia memory cards, and it comes with one 8-megabyte card. That is enough memory to store up to 122 640 × 480 SQ images or seven 1600 × 1200 SHQ images. The 8 megabytes will store only one 1600 × 1200 TIFF image. You can swap re-usable SmartMedia cards with higher or lower capacities like rolls of film. Except for buffering, the camera has no built-in memory.

The C-2000 Zoom has an all-glass, 8-element 3× zoom lens with a 35mm equivalency of 35 to 105mm and an aperture from f2.0 to f11. The camera also has a digital telephoto feature that works at any optical focal length. The digital telephoto provides 1.6×, 2×, and 2.5× magnification, and when used in conjunction with the optical zoom, the camera provides the equivalent of a 260mm lens. A macro capability allows focusing from as close as eight inches. The C-2000 Zoom also offers the user a choice of 100, 200, or 400 ISO film speed equivalency.

A built-in 1.8-inch LCD lets users review and compose images. Stored images can be inspected at up to 3× magnification, and the area of inspection can be moved as necessary. The C-2000 Zoom also has a video output for viewing stored images on a TV set or for transferring them to videotape. An included remote control allows images to be selected and viewed on a TV while seated at a distance from the camera.

The C-2000 Zoom has a built-in flash with four modes including red-eye reduction, force-fill, low-light/backlight, and force-off. External lighting can be synchronized to the camera, and the automatic metering system can be manually overridden.

Like most digital cameras, the C-2000 Zoom can link to a PC through the serial port. But a much slicker solution is Olympus' optional FlashPath floppy disk adapter. FlashPath looks like a regular floppy disk, but it has a slot on one side that SmartMedia cards slip into. After a quick software installation from an included diskette, a PC will recognize the FlashPath adapter as a floppy disk but with the capacity of the inserted SmartMedia card. Though it isn't terribly fast, FlashPath is an elegant image transferring solution that eliminates the need for any cables.

Olympus SmartMedia cards are specially formatted to allow the camera to lock successive exposure settings to that of the first exposure in a panoramic set of images. The included QuickStitch panorama software is then used to join multiple images together (tall and wide) for impressive panoramic and increased overall image resolution. Adobe PhotoDeluxe image manipulation and creation software is also included with the camera,

(Continued on page 97)

Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

One-RPM Stepper

Q *For an astronomical instrument, I need to make a stepper motor turn at exactly 1 revolution per minute (rpm). The motor is a Mitsumi M68SP-4 unit with six wires. It moves in 1.8-degree steps. How do I do this?—M. McA., Tucson, AZ*

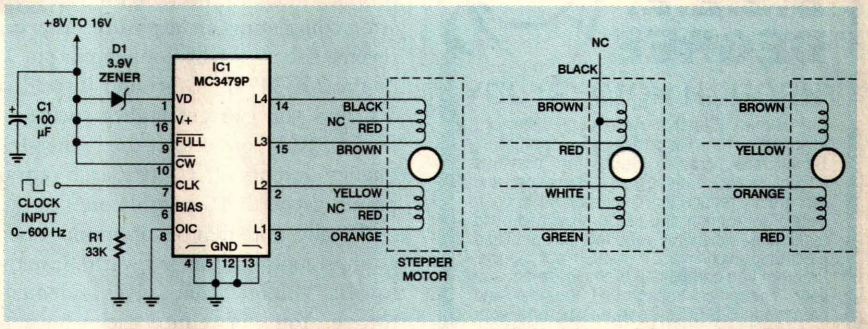


FIG. 1—MOTOROLA'S MC3479P CAN BE USED to drive most 4-, 5-, and 6-wire stepper motors with a minimum of additional components. To be on the safe side, don't assume your motor's wire colors match what's shown here; check things out with an ohmmeter to be sure.

A Your letter explains that you're building a "barn-door tracker," a simple gadget that lets you take long-exposure photographs of the stars by compensating for the earth's rotation. It consists of two pieces of wood, hinged together, with the axle of the hinges pointed toward Polaris and therefore parallel to the earth's axis. The hinges gradually swing open at an angular rate equal to the earth's rotation as the wooden panels are pushed apart by 20-thread-per-inch screw rotating at 1 rpm and positioned exactly 290mm from the hinge axle. Naturally, the device can only open up a few degrees before you have to reset the screw, but that's enough for a time exposure of five or ten minutes. For details, see *Astrophotography for the Amateur*, by Michael Covington, 1999 edition, pp. 120-121, or do a Web search for "barn-door tracker" or "Scotch mount."

Most people turn the handle of a barn-door tracker by hand, but you've elected to use a stepper motor. Accordingly, this is a two-part question: how to run a stepper motor, and how to get the desired speed. Let's tackle the second part first.

A stepper motor turns when its windings are energized in a specific sequence, and by far the easiest way to do this is to use a stepper motor driver chip such as the Motorola MC3479P (see Fig. 1). This chip moves the motor in either full or half steps depending on whether pin 9 is connected to V+ or to ground. Each step is triggered in turn by a clock pulse on pin 7.

Since your motor makes 1.8-degree steps, it needs 200 pulses (or, in half-step mode, 400 pulses) to make a complete circle. A frequency of 400 cycles per minute equals 6.667 cycles per second (Hertz). Accordingly, the second part of the task is to generate a precise 6.667-Hz clock signal.

That was the challenging part. The easy way would be to program a microcontroller to count the appropriate number of microseconds for each cycle. However, you requested a design using off-the-shelf parts, and after trying lots of combinations I came up with the quartz-controlled circuit in Fig. 2. Here a standard 4.9152-MHz microprocessor crystal is used with a CD4060 (MC14060) CMOS oscillator-divider, which divides it down to 600 Hz. Then two CD4017 (MC14017) decade counters divide the frequency by 9 and by 10, respectively. The output is a 6.667-Hz square wave.

Several cautionary notes: In the oscillator-divider circuit, don't use 74HC chips (74HC4060, 74HC4017) unless you're using a regulated 5-volt supply. In the motor circuit, the MC3479P can handle a maximum of 350 mA; for heavier currents than that, you need a similar but slightly different chip, the SAA1042A, described in this column in August 1996.

The color code for stepper-motor wires seems to vary haphazardly, so use an ohmmeter to check out your particular motor before hooking it up. If the windings have center taps (yours do),

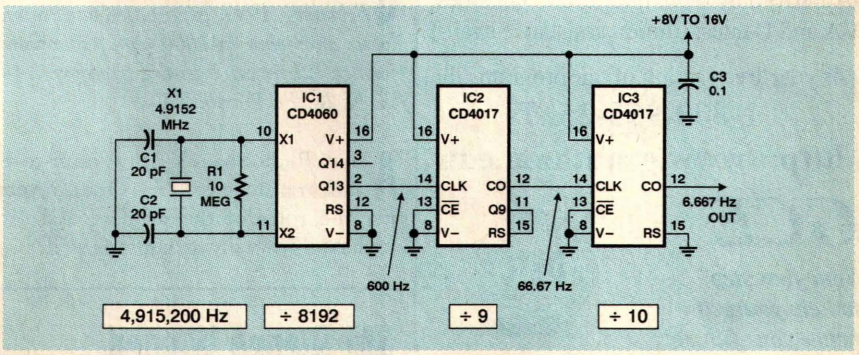


FIG. 2—THIS CIRCUIT GENERATES a precise 6.667-Hz clock signal using off-the-shelf components. The 4.1952-MHz crystal (X1) is used in many microprocessor circuits and is easy to find.

ATTENTION! ELECTRONICS TECHNICIANS

EARN YOUR
B.S.E.E.
DEGREE
THROUGH HOME STUDY

Our Highly Effective Advanced-Placement Program for experienced Electronic Technicians grants credit for previous Schooling and Professional Experience, and can greatly reduce the time required to complete the program and reach graduation. No residence schooling required for qualified Electronic Technicians. Through our Special Program you can pull all of the loose ends of your electronics background together and earn your B.S.E.E. Degree. Upgrade your status and pay to the engineering level. Advance rapidly! Many finish in 12 months or less! Students and graduates in all 50 states and throughout the world! Established Over 50 Years! Write or call for free Descriptive Literature. (601) 371-1351

COOK'S INSTITUTE
OF ELECTRONICS ENGINEERING
4251 CYPRESS DRIVE
JACKSON, MISSISSIPPI 39212

CIRCLE 58 ON FREE INFORMATION CARD

Accredited B.S. Degree in Computers or Electronics
by studying at Home

Grantham College of Engineering
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

NEW
-Electronics Workbench Professional 5.0 included in our B.S.E.T curriculums
-Approved by more than 200 Companies, VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial
1-800-955-2527
http://www.grantham.edu

GCE
Your first step to help yourself better your future!

DISTANCE EDUCATION AND TRAINING COUNCIL DETC ACCREDITED MEMBER

Grantham College of Engineering
34641 Grantham College Road
Slidell, LA 70460-6815

leave them unconnected. If the motor turns the wrong way, reverse the connections to one of the windings. With a motor that moves in 3.6-degree steps (100 steps or 200 half-steps per full circle), you'll need to cut the clock speed in half; you can do this by feeding IC2 from pin 3 of IC1 instead of pin 2.

You may want to implement a "fast reverse" mode for backing the screw out after completing an exposure. You can reverse the motor by connecting pin 10 of the MC3479P to ground instead of V+, and you can get higher speeds by feeding IC2 from one of the higher-frequency outputs of IC1 (try each output pin until you find a suitable one).

Finally, note that in continuous operation, stepper motors get warm. Use the lowest voltage that gives adequate torque. You can reduce the voltage to the motor by including some silicon rectifiers (1N4001 or equivalent) in series with the power supply; each one takes off about 0.7 volt, and they also protect against an accidentally reversed battery.

The MC3479P and some motors that work well with it are available from Jameco, 1355 Shoreway Road, Belmont, CA 94002; Tel: 800-831-4242; Web: www.jameco.com. Suitable motors are very common in junked printers and the like; it may be that all you need is the chip. The ECG1857 and NTE1857 are exact substitutes for the MC3479P.

To learn more about stepper motors, see "Robotics Workshop" in **Popular Electronics**, July 1999, pp. 64—66, 70 (available from our Reprint Bookstore) and Doug Jones' stepper motor FAQ on the Web at www.cs.uiowa.edu/~jones/step.

Audio Transformer Query

Q *I'd like to build the intercom in your February, 1997, issue, p. 14, but I cannot locate an 8-ohm-to-1000-ohm audio transformer. Where can I get this transformer?—G. N. K., Ft. Worth, TX*

A Use RadioShack's 1000-ohm-to-8-ohm transformer (273-1380), reversing the roles of the primary and secondary. That will work just as well.

AM Stereo Wanted

Q *Is there a circuit or a chip that will add AM stereo capability to an existing AM radio?—R. A. H., Lancaster, OH*

A Somehow, AM stereo has never been the commercial success that was predicted, perhaps because the talk-radio boom came along at about the same time. But it hasn't died out, either.

We published an AM stereo conversion circuit in our January 1984 issue, pages 41—46, 102, and 114 (see also the May 1984 issue, p. 20). It used a Motorola MC13020P chip, which is going out of production and may be hard to find.

You can buy a wide range of AM stereo receivers and tuners from AM Stereo Works (1555 State Road 207, St. Augustine, FL 32086; Tel: 904-810-5140; Web: www.stereoam.com). They have conversion kits for existing receivers, but they are fairly expensive (about $90); they can also convert your radio for you.

Pager Transmitter?

Q *Is there a way to rig a 9-volt transmitter to directly activate my pager (without going through the telephone lines or my pager company) when a motion detector is triggered?—H.E.R., Shell Beach, CA*

A It doesn't sound easy. You'd have to mimic the activation code sent to your pager by the pager company, which may be a fairly complicated signal. Consider using a separate receiver (such as a pocket FM radio) and building one of the FM transmitters in **Popular Electronics,** July 1999, pp. 37—42 . On using your PC to generate the digital codes used by pagers, see **Electronics Now**, February 1998 issue, pp. 42—45.

Parallel 4049s; Another Chip Quest

Q *Is it possible to connect two or more elements of the MC14049 (CD4049) buffer/inverter chip to increase the drive and sink capability?*

Also, I would appreciate any information you can give me about the BTS629 7-pin automotive dimmer chip.—S. B., Missisauga, Ont., Canada

A Your first question is easy: Yes, CMOS inverters (including units of the 4049) can be paralleled to increase their output current capacity. Connect

inputs together and outputs together. I have sometimes paralleled all six gates for this purpose.

I wasn't able to track down the BTS629. The BTS prefix suggests it may be a Siemens (now Infineon) product, but it is not in their current product listing. Their BTS630 sounds like what you're asking about; it is a 7-pin, TO-220-packaged power controller that uses pulse-width modulation. That is, it switches the power on and off very rapidly, varying the percentage of the time that it is on. You can get a data sheet from Infineon's web site (www.infineon.com) or by writing to Infineon Technologies AG, P.O. Box 800949, 81609 Munich, Germany. They can also refer you to Infineon distributors in your area.

Infrared Link

Q *I need to increase the range of an infrared-linked computer and printer. Is it possible to transmit infrared over a fiber-optic cable? Is it possible to increase the range of the IR relay in your Fall 1994* **Electronics Hobbyists' Handbook***?—G. R., Anchorage, AK*

A Using a fiber-optic cable sounds like the easiest solution; infrared signals should pass through it just fine. (If you try this, write again and let us know how well it worked.) As for the repeater circuit, you can place the LEDs a long way from the rest of the device, connected by speaker wire. But first make sure the repeater will work with your computer. Infrared data signals are chopped (switched on and off) at a high frequency (around 40 kHz), to distinguish them from other sources of infrared light, and your computer may not be using the same frequency as a TV remote control.

Ultrasonic Listener Found

Q *In the July issue, a reader asked for plans for an ultrasonic listening device.* **Popular Electronics** *has had at least two that I know of, one in the December 1994 issue (pp. 74—75) and one in February 1989 (pp. 46—48, 103).—Mick Palmer, by e-mail*

A Thanks! The 1989 project does exactly what the reader requested.

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to:

(1) include plenty of background information (we'll shorten your letter for publication);

(2) give your full name and address on your letter (not just the envelope);

(3) type your letter if possible, or write very neatly; and

(4) if you are asking about a circuit, include a complete diagram.

Questions can be sent to Q&A, **Electronics Now** Magazine, 500 Bi-County Blvd., Farmingdale, NY 11735, or e-mailed to q&a@gernsback.com, but please do not expect an immediate reply (because of our backlog) and please don't send graphics files larger than 100K. Due to the volume of mail, we regret that we cannot give personal replies.

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at http://www.gernsback.com for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci. elec tronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio. amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at http://www.hitex.com/chipdir/, or try addresses such as http://www.ti.com and http://www. motorola.com (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. www.questlink.com features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from www.icmaster.com, which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at www.repairfaq.org

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1994 only) are available from our Claggk, Inc., Reprint Department, P.O Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (http://www.arrl.org). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

BY SAM GOLDWASSER
SERVICE EDITOR

Testing Semiconductors

THIS MONTH WE WILL TAKE A BREAK FROM HEAVY TROUBLESHOOTING TO GO OVER SOME OF THE BASIC TECHNIQUES FOR TESTING OF COMMON SEMICONDUCTORS. WHILE FANCY TRANSISTOR TESTERS AND CURVE TRACERS HAVE THEIR place, when you just want to know if your horizontal output transistor is toast or not they can be more trouble than they are worth. Most (though not all) failures of diodes, transistors, SCRs, and so forth, result in unambiguous changes to the device parameters that can be found with very simple tests typically using a DMM or VOM, a power supply, and a few resistors.

In most cases, these simple tests will identify bad silicon transistors. Gain, frequency response, etc., are not addressed here. While the tests can be applied to germanium devices, these are more likely to change characteristics, it would seem, without totally failing.

Safety Considerations

None of the tests described here require probing live circuits. However, before touching, probing, or unsoldering any component, make sure the equipment is unplugged and any large capacitors have been safely discharged. Not only can coming in contact with a live circuit or charged capacitor ruin your day, but your test equipment could be damaged or destroyed as well.

VOMs and DMMs

Analog and digital meters behave quite differently when testing nonlinear devices like diodes and transistors. For example, it is important to remember that an analog VOM on the lowest resistance range could put out too much current for smaller devices, possibly damaging them. Ironically, this is more likely with better meters like the Simpson 260, which can test to lower ohms (×1 scale). Use the next higher resistance range in this case or a DMM, as those never drive the device under test with significant current. However, this can result in false readings as the current may be too low to adequately bias the junctions of some power devices or devices with built-in resistors.

Testing Diode Junctions with a Multimeter

On the (analog) VOM, use the low ohms scale. A regular signal diode or rectifier should read a low resistance (typically ⅔ scale or a couple hundred ohms) in the forward direction and infinite (nearly) resistance in the reverse direction. It should not read near 0 ohms (shorted) or open in both directions. A germanium diode will result in a higher scale reading (lower resistance) due to its lower voltage drop.

For the VOM, you are measuring the resistance at a particular (low current) operating point—this is not the actual resistance that you will see in a power rectifier circuit, for example.

On a (digital) DMM, there will usually be a diode-test mode. Using this, a silicon diode should read between 0.5 to 0.8 V in the forward direction and open in reverse. For a germanium diode, it will be lower, perhaps 0.2 to 0.4 V or so in the forward direction. Using the normal resistance ranges—any of them—will usually show open for any semiconductor junction since the meter does not apply enough voltage to reach the value of the forward drop. Note, however, that a defective diode may indeed indicate a resistance lower than infinity especially on the highest ohms range. So, any reading of this sort would be an indication of a bad device but the opposite is not guaranteed.

Note: For a VOM, the polarity of the probes is often reversed from what you would expect from the color coding—the red lead is negative with respect to the black one. DMMs usually have the polarity as you would expect it. Confirm this using a known diode as a reference. Also, "calibrate" your meter with both silicon and germanium semiconductors so you will know what to expect with an unknown device.

Transistor Testing Methodology

As with diode junctions, most digital meters show infinite resistance for all six

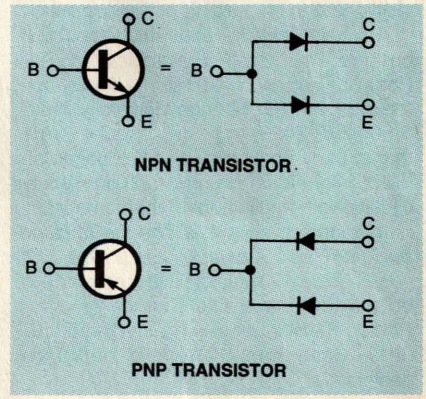


FIG. 1—A BIPOLAR TRANSISTOR can be modeled using diodes.

combinations of junction measurements since their effective resistance-test voltage is less than a diode junction drop (if you accidentally get your skin involved it will show something between 200K and 2M ohms). The best way to test transistors with a DMM is to make use of the "diode-test" function, which will be described after we talk about testing with an analog meter. Regardless of whether you test with an analog or digital meter, if you read a short circuit (0 ohms or voltage drop of 0) or the transistor fails any of the readings, it is bad and must be replaced. This discussion is for **out-of-circuit** transistors **only**.

One exception to this occurs with some power transistors, which have built-in diodes (damper diodes reverse connected across the C-E junction) and resistors (B-E, around 50 ohms) that will confuse these readings. If you are testing a transistor of this type—horizontal output transistors are the most common example—you will need to compare with a known good transistor or check the specifications to be sure. There are some other cases as well. So, if you get readings that do not make sense, try to confirm with a known good transistors of the same type or with a spec sheet.

Before testing an unknown device, it is best to confirm and label lead polarity (of voltage provided in resistance or diode test mode) of your meter whether it be an analog VOM or digital DMM using a known good diode (*e.g.*, 1N4007 rectifier or 1N4148 signal diode) as discussed below. This will also show you what to expect for a reading of a forward-biased junction. If you expect any germanium devices, you should do this with a germanium diode as well (*e.g.*, 1N34).

Note that this discussion assumes that a transistor can be tested for shorts, opens, or leakage, as though it is just a pair of connected diodes. The equivalent diode circuits for NPN and PNP bipolar transistors are shown in Fig. 1.

Obviously, simple diodes can be tested as well using this technique. However, LEDs (their forward drop is too high for most meters) and Zeners (their reverse breakdown—Zener voltage—is too large for most meters) cannot be fully tested in this manner. Those and other types of devices are discussed later in this article.

Testing With an Analog VOM

For NPN transistors, lead "A" is black and lead "B" is red; for PNP transistors, lead "A" is red and lead "B" is black (Note: This is the standard polarity for resistance, but many multimeters have the colors reversed since this makes the internal circuitry easier to design; if the readings don't jive this way, switch the leads and try it again). Start with lead "A" of your multimeter on the base and lead "B" on the emitter. You should get a reasonable low resistance reading. Depending on scale, this could be anywhere from 100 ohms to several thousand ohms. The actual value is not critical as long as it is similar to the reading you got with your "known good diode test" above. All silicon devices will produce somewhat similar readings and all germanium devices will result in similar but lower resistance readings.

Now move lead "B" to the collector. You should get nearly the same reading. Now try the other four combinations, and you should get a reading of infinite ohms (open circuit). If any of those resistances is wrong, replace the transistor. Only two of the six possible combinations should show a low resistance; none of the resistances should be near 0 ohms (shorted).

As noted above, some types of devices include built-in diodes or resistors, which can confuse these measurements.

Testing With a Digital DMM

Set your meter to the diode test. Connect the red meter lead to the base of the transistor. Connect the black meter lead to the emitter. A good NPN transistor will read a junction drop voltage of between 0.45v and 0.9v. A good PNP transistor will read open. Leave the red meter lead on the base and move the black lead to the collector. The reading should be the same as the previous test. Reverse the meter leads in your hands and repeat the test. This time, connect the black meter lead to the base of the transistor. Connect the red meter lead to the emitter. A good PNP transistor will read a junction drop voltage of between 0.45 V and 0.9 V. A good NPN transistor will read open. Leave the black meter lead on the base and move the red lead to the collector. The reading should be the same as the previous test. Place one meter lead on the collector, the other on the emitter. The meter should read open. Reverse your meter leads. The meter should read open. This is the same for both NPN and PNP transistors.

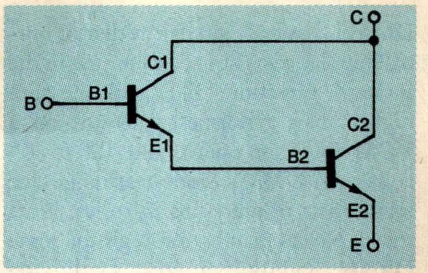


FIG. 2—A DARLINGTON TRANSISTOR is two transistors within a single package and is connected as shown here.

Again, as noted, some transistors will have built-in diodes or resistors which can confuse these readings.

Testing Power Transistors

Power transistors without internal damper diodes test just about like small signal transistors using the dual diode model, high in one direction, either B-E or B-C. If there is a built-in damper diode, it is across C-E junction and is back biased under normal operating conditions. Therefore, a reading between C-E will also test low in one direction and B-C will show a double diode drop in the reverse direction.

Also, there is often a low value resistor—about 50 ohms—between B-E when there is a built-in damper. This will show up as a nearly zero-volt junction drop on the diode test scale of a DMM, but such a reading does not indicate a bad part. Use the resistance scale to confirm.

Testing Darlington Transistors

A Darlington transistor—see Fig. 2—is a special type of configuration usually consisting of 2 transistors fabricated on the same chip or at least mounted in the same package. Discrete implementations as well as Darlingtons with more than 2 transistors are also possible.

In many ways, a Darlington configuration behaves like a single transistor where:

- the current gains of the individual transistors it is composed of are multiplied together and,
- the B-E voltage drops of the individual transistors it is composed of are added together.

Darlingtons are used where drive is limited and the high gain—typically over 1000—is needed. Frequency response is not usually that great, however.

Testing a Darlington with a VOM or

DMM is basically similar to that of normal bipolar transistors, except that in the forward direction, B-E will measure higher than a normal transistor on a VOM (but not open), and 1.2 to 1.4 volts on a DMM's diode-test range due to the pair of junctions in series. Note that 1.2 volts may be too high for some DMMs, and thus a good Darlington may test open—confirm that the open circuit reading on your DMM is higher than 1.4 volts or check with a known good Darlington.

Testing Digital or Bias Resistor Transistors

Occasionally you may find a transistor that includes an internal bias resistor network attached to the base and emitter so that it can be driven directly from a digital (e.g., TTL) source; see Fig. 3. These may be used in consumer elec-

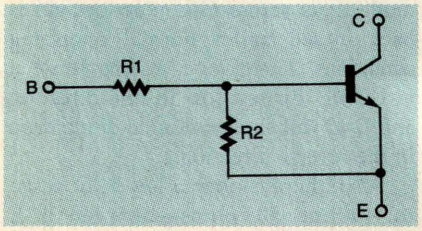


FIG. 3—AN INTERNAL BIAS RESISTOR is sometimes present to allow a transistor to be driven directly from a TTL-level signal.

tronics equipment where space is critical, or for no good reason other than to make it difficult to locate a suitable replacement device!

The addition of R1 makes testing with a multimeter other than for shorts more difficult. With a VOM, you should see a difference in the B-E and B-C junctions in the forward and reverse directions. However, a DMM will probably read open across all pairs of terminals.

Testing Zener Diodes

The following applies to both testing of Zeners for failure and determining the ratings of an unknown device:

With a VOM, a good Zener diode should read like a normal diode in the forward direction and open in the reverse direction unless the VOM applies more than the Zener voltage for the device. A DMM on its diode test range may read the actual Zener voltage if it is very low (*e.g.*, a couple of volts) but will read open otherwise. The most common failure would be for the device to short—read 0.0 ohms in both direc-

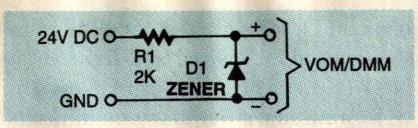


FIG. 4—USE THIS CIRCUIT to test Zener diodes.

tions. Then, it is definitely dead!

Some Zeners are marked with a JEDEC (1N) part number, others with a couple of colored bands (*e.g.*, for 18 volts the bands would be brown and gray), or a house number or house color code.

You can easily test a Zener and identify its voltage rating with a DC power supply, resistor, and multimeter. You will need a power supply (a DC wall adapter or AC wall adapter with a rectifier and filter capacitor is fine) greater than the highest Zener voltage you want to test. Select a resistor that will limit current to a few mA. For example, for Zeners up to about 20 V, you can use the circuit in Fig. 4. This same approach applies to other devices that exhibit a similar behavior, such as the B-E junction of a bipolar transistor.

Testing Unijunction and Programmable Unijunction Transistors

Unijunction Transistors (UJTs) and Programmable Unijunction Transistors (PUTs) are used in similar sorts of circuits, though the UJT is all but extinct. They both exhibit a negative resistance characteristic and can be used easily in low to medium frequency free-running relaxation oscillators and other trigger type circuits.

The UJT (see Fig. 5) goes into heavy conduction from E to B1 when E becomes more positive than a critical trigger voltage, $V_T = n \times V_{BB} + 0.6$. (Note, n, the "intrinsic standoff voltage," is typically about 0.6.) It continues to conduct until the emitter current drops

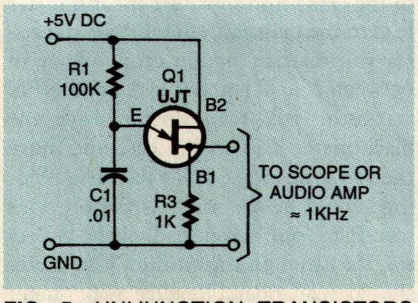


FIG. 5—UNIJUNCTION TRANSISTORS are not that common these days, but if you come across one this circuit can be used to test it.

below some minimum 'valley current' value. (Sounds sort of like a thyristor, right?)

The PUT (see Fig. 6) is even more like a thyristor in that the triggering takes place when the G terminal becomes more positive than the A (probably plus a diode drop, 0.6 V) so that the threshold voltage can now be set with a voltage divider feeding the anode.

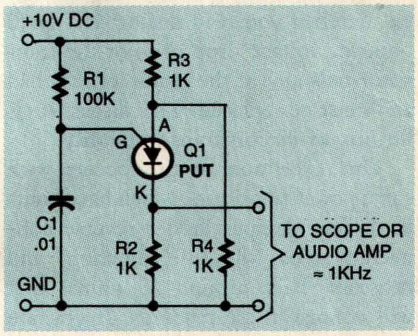


FIG. 6—A CIRCUIT FOR TESTING programmable unijunction transistors (PUTs) is shown here.

Then, current flows from the G to the K terminal. Note that its leads are even labeled like an SCR, but it behaves sort of backwards!

For an initial test, check between B1 and B2 (UJT) or A and K (PUT) with an ohmmeter. The resistance should be the same in both directions and typically a few thousand ohms or more. A short or wildly different readings would indicate a bad device. This doesn't prove that the device is good—only that it hasn't blown up. A more complete test requires a simple circuit and some means of detecting an audio output signal. For the UJT, use the set up in Fig. 5; for the PUT, an additional voltage divider (R3 and R4) is needed to set the threshold as shown in Fig. 6.

Testing SCRs and Triacs

Next, let's deal with testing various types of thyristors. For SCRs, the gate to cathode should test like a diode (which it is) on a multimeter. The anode to cathode and gate to anode junctions should read open. For Triacs, the gate to main terminal 2 (MT2) should test like a diode junction in both directions. MT1 to MT2 and the gate to MT1 junctions should read open. For diacs and sidacs, there is no gate terminal—resistance should be infinite in both directions.

Note: Some thyristors will have a low G-K/MT2 resistance but it should not read as a short.

The real test is quite simple but will

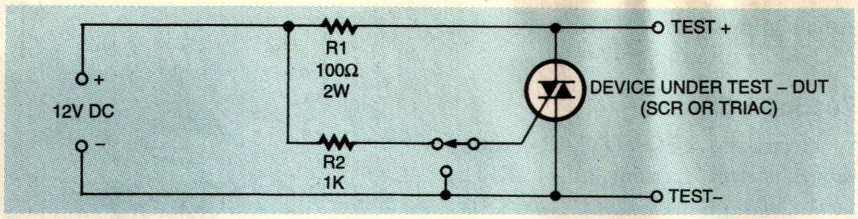


FIG. 7—IN THIS SCR/TRIAC test circuit, R1 limits current to the device under test, and R2 limits current to its gate.

require a low voltage DC power supply and two resistors. For Triacs, a negative output from the supply is also desirable to test the triggering when the gate is negative.

To test SCRs or Triacs, use the circuit shown in Fig. 7. There, R1 is used to limit current through the device and R2 is used to limit current to the gate. The 12-VDC supply should be capable of currents to at least 200 mA. Note that R1 calls for a unit with a 2-watt rating; a /-watt unit should be sufficient for R2. Those ratings should work for testing most small to medium power devices. Check the "minimum gate current" and "holding current" specs to be sure. For larger devices, R1 and/or R2 might need to be smaller.

Here's the procedure:

1. Connect the supply as shown.
2. Trigger the gate from the positive of the supply through the current limiting resistor (R2) and see that the DUT turns on and stays on when the gate is disconnected.
3. Open the circuit to the anode (with the gate connected to the cathode) and again reconnect the anode resistor. The DUT should now be off again.
4. For Triacs, repeat steps (2) and (3) with R2 supplied from a negative voltage.

If the device passes these tests, it is behaving properly and is probably functional. However, without applying full voltage or current, there is no way of knowing if it will meet all specifications.

You can replace the DC supply with a low voltage power transformer (say, 12 VAC). Use a scope to monitor the voltage across the DUT or R1. Then, when the gate is connected to R2, you should see the voltage across the DUT drop to nearly zero when it switches on partway through the positive cycle. This phase will be determined by the voltage and value of R2. It should remain off for the entire negative cycle (SCRs only) with the gate connected and remain off all the time with the gate connected to the cathode.

Testing Diacs and Sidacs

Diacs and Sidacs are thyristors without a gate terminal. They depend on the leakage current to switch them on once the voltage across the device exceeds their specified ratings. With an ohmmeter, they can be tested only for shorts. Resistance should be infinite in both directions.

However, you can test a diac or sidac with a resistor, variable power supply (you will need at least the rating of the device), and a DMM. Hook them in series as shown in Fig. 8 and monitor across the device. With care, your variable supply can be a Variac, a 1N4007 diode, and 1 μF, 200 V capacitor as shown. The 47,000-ohm resistor (R1) is used to limit the current:

CAUTION: This circuit is not isolated from the power line. I recommend using an isolation transformer between the variable voltage source (Variac) and the power line for safety. If the DUT is rated at more than about 180 volts, you will need to use a doubler and higher-voltage capacitor, but testing is otherwise similar.

As you increase the input, the voltage on the DUT will track it until the rated voltage, at which point it will drop abruptly to zero and stay there until the voltage is reduced below its holding current. Repeat with the opposite polarity.

With a scope, testing is even easier as you can use an AC supply directly (remove D1 and C1) and observe that the DUT will turn on at the proper voltage on both polarities of the AC waveform and stay on until the voltage crosses 0. But, again, use an isolation transformer for safety.

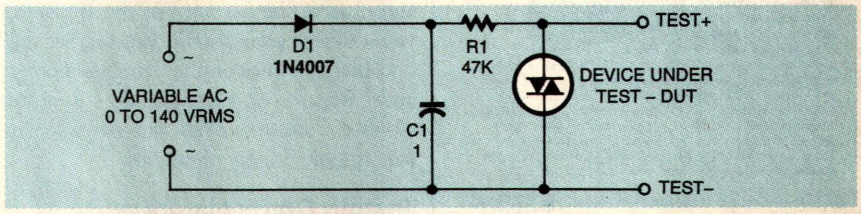


FIG. 8—A DIAC OR SIDAC is a thyristor without a gate. Use this circuit to test one.

Identifying Unknown Bipolar Transistors

The type (NPN or PNP) and lead arrangement of unmarked transistors can be determined using a multimeter and the back-to-back diode model discussed earlier. The collector and emitter can be identified based on the fact that the doping for the B-E junction is always much higher than for the B-C junction. Therefore, the forward voltage drop will be very slightly higher—this will show up as a couple of millivolts (sometimes more) difference on a DMM's diode-test scale or a slightly higher resistance on an analog VOM.

To determine the lead arrangement, label the pins on the unknown device 1, 2, and 3. Put the positive probe (as determined previously) of your multimeter on pin 1. Now, measure the resistance (VOM) or diode drop (DMM) to the other two pins. If the positive probe is on the base of a good NPN transistor, you should get low resistance readings or a low diode drop to the other two leads. The B-C resistance or diode drop will be just slightly lower than the B-E reading.

If one or both measurements to the other two pins is high, put the positive probe on pin 2 and try again. If still no cigar, try pin 3.

If this still doesn't work, you may have a PNP transistor—repeat with the negative probe as the common pin.

If none of the six combinations yields a pair of low readings—or if more than one combination results in a pair of low readings, your transistor is likely bad—or it is not a bipolar transistor at all!

As noted, some power transistors have built-in base resistors or damper diodes and will confuse these measurements. However, the lead arrangement of these types of transistors is usually self-evident (standard TO3, TOP3, or TO220 cases). There are also some tran-

sistors with series base resistors that may prove confusing. These are relatively rare, however.

Testing MOSFETs

Verify that the gate has infinite resistance to both drain and source. There is one exception to that: FETs with protection circuitry may act like there is a Zener shunting the gate and source terminals (*i.e.*, diode drop for gate reverse bias, about 20-volts breakdown in forward bias).

Connect the gate to the source. The drain to source junction should act like a diode.

Forward bias the gate-source junction with about 5 volts. The drain-source junction in forward bias should measure very low resistance. In reverse bias, it will still act like a diode.

The usual failure mode you are likely to see with these devices is both a gate-source and drain-source short: In other words, everything connected together. Also, when handling these devices remember that MOSFETs are static sensitive!

Testing LEDs

Electrically, LEDs (and IR-emitting diodes, strictly speaking called IREDs) behave like ordinary diodes except that their forward voltage drop is higher. Typical values are IR: 1.2 volts; Red: 1.85 volts; Yellow: 2 volts; and Green: 2.15 volts. The new blue LEDs will be somewhat higher (perhaps 3 volts). These voltages are at reasonable forward current. Depending on the actual technology (*i.e.*, compounds like GaAsP, GaP, GaAsP/GaP, GaAlAs, etc.), actual voltages can vary quite a bit. For example, the forward voltage drop of red LEDs may range at least from 1.5 to 2.1 volts. Therefore, LED voltage drop is not a reliable test of color, though multiple samples of similar LEDs should be very close. Obviously, if the device is good, it will also be emitting light when driven in this way if the current is high enough.

You can test for shorts and opens with a multimeter (but it must be able to supply more than the forward voltage drop to show a non-open condition). However, an LED can be weak and still pass the electrical tests, so checking for output is still necessary. Therefore, even if these tests don't find a problem, drive the LED from a DC supply and appropriate current-limiting resistor and observe the output. For the IR types, you will need a suitable IR detector. See the document: "Notes on the Troubleshooting and Repair of Hand-Held Remote Controls" on my Web site (www.repairfaq.org) for a variety of options.

Testing Optoisolators and Photo-Interrupters

Both of these classes of components are basically similar: a light source (usually an IR LED) and photodetector together in a single package. The optoisolator will be totally sealed with adequate separation between the two parts to provide the specified isolation voltage rating. The photo-interrupter (and similar devices) will provide a beam path that can be blocked or otherwise modified by external means.

For both types, the photodetector can be a photodiode, phototransistor, photothyristor, or another more complex device or circuit. Refer to an optoelectronics databook or the catalog of a large electronics distributor for specific pinouts and specifications.

Assuming a photodiode or photo-transistor type (most common), these can be tested for basic functionality pretty easily. Wire up the test circuit shown in Fig. 9. Depressing S1 should result in the output dropping from +5 volts to close to 0. For monitoring on a scope, drive the LED with a pulse generator and current-limiting resistor instead of S1. With a photo-interrupter type, blocking or adding a reflector to the optical path (as appropriate) should result in similar behavior.

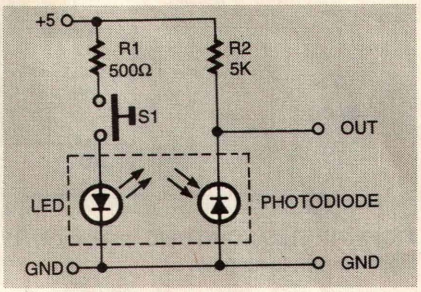


FIG. 9—A SIMPLE CIRCUIT for testing opto-isolators.

Testing Thermistors

There are two types of thermistors: Positive Temperature Coefficient (PTC) types have a resistance that increases with increasing temperature. Negative Temperature Coefficient (NTC) types have a resistance that decreases with increasing temperature.

For a small thermistor, put an ohmmeter on it and heat the device under test with a blow dryer, heat gun, or the tip of a soldering iron—the resistance should change smoothly (up or down depending on whether it is PTC or NTC type). If the resistance changes erratically or goes to infinity or zero, the device is bad. However, you will need specifications, temperature measuring sensors, etc., to really determine if it is operating correctly.

Wrap-Up

Next time, we will continue our discussion of semiconductor testing with additional service-related information and some very simple curve tracer and in-circuit tester schematics. In a future column, we'll discuss the specific problem of testing the laser diodes found in CD and DVD equipment and laser printers. Until then, check out my Web site: www.repairfaq.org. I welcome comments (via e-mail please at sam@stdavids.picker.com) of all types and will reply promptly to requests for information. See you next time! EN

GALEP-III
Pocket Multiprogrammer

This size fits all!

◆ Programs 8-bit and 16-bit EPROMs, EEPROMs, Zero Power RAMs, Flash, serial EEPROMs ◆ GAL, PALCE, ATF ◆ 87xxx, 89xxx, PIC12/16/17Cxx ◆ All DIL devices **without adaptor** ◆ **Lightning fast** parallel data transfer (e.g. 27C512 read/compare 2 sec!) ◆ Power supply independent due to **rechargeable battery** ◆ Uses PC printer port ◆ Hex, JEDEC, and binary file formats ◆ Hex and fusemap buffer editor ◆ Split & shuffle for 8-bit, 16-bit and 32-bit targets ◆ Runs under Win3.1, 95, 98 ◆ 'Remote control' by DDE scripts ◆ Designed for the future due to flexible pin driver technology - new devices will be added every month ◆ Device list, demo software and **lifetime free updates** from our website www.conitec.com!

GALEP-III Set with cable, battery, recharger... **$333.00**
PLCC Adaptor for 8-bit EPROMs / 16-bit EPROMs / GALs .... **each $149.00**

CONITEC 1951 4th Ave, Ste 301 • San Diego, CA 92101 Tel: (619) 702-4420 • http://www.conitec.com

THE TRANSDUCER PROJECT BOOK

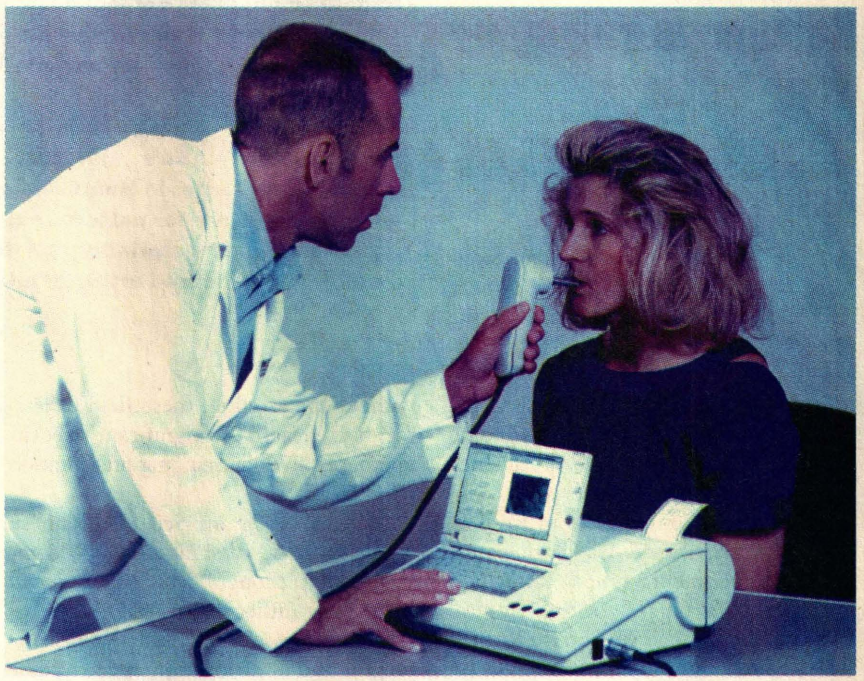
1992T—From TAB Books. A unique collection of practical transducer devices that you can put together simply and inexpensively. You can build a seismic sensor, a temperature survey meter, an open-door annunciator, a moisture detector, an automatic night light, and more. To order—ask for book **1992T**, and include your check for **$6.99 - clearance (includes s&h)** in the US and Canada, and order from **—Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240.** US funds only; use US bank check or International money order. Allow 6-8 weeks for delivery. MA06

Prototype

Blood Tests Without Needle Sticks

Thanks to a new electronic diagnostic aid, those annoying and even sometimes painful finger pricks to obtain blood samples could soon be a thing of the past. The name of this new medical device is the Hemoscan, and it is being developed by a Philadelphia-based company called Cytometrics.

With the Hemoscan, a probe is placed under the tongue much like a thermometer. The doctor or medical technician could then immediately read the red blood cell count and hemoglobin levels. Results would be displayed on a screen of the unit, which looks much like a laptop computer. The results of the test would also be printed out so that they can be included in the patient's records.



WITH THE HEMOSCAN, hemoglobin (Hb) and hematocrit (Hct) levels are measured by placing the probe under the tongue and results are displayed immediately on a device that resembles a laptop computer.

How it Works

The Hemoscan is a small, portable instrument with a hand-held probe attached to a computer imaging unit. Illuminated by a light source, the device captures reflected images of blood flowing through the tiny capillaries in the mouth's underlying mucous membrane. Then, using image-processing technology, the Hemoscan analyzes the different wavelengths of reflected light to calculate the patient's hemoglobin (Hb) and hematocrit (Hct) levels without drawing any blood.

Benefits

There are other benefits from using the Hemoscan besides eliminating the discomfort of a needle prick. This technique moves Complete Blood Count (CBC) testing from the clinical laboratory to the point-of-care. This makes results available immediately rather than having to wait hours or even days for results to come back from the laboratory. Since there is no blood drawn, the Hemoscan eliminates the risk of exposure to AIDS and other blood-borne diseases. Other advantages include reducing hazardous biomedical waste that has to be disposed of and an overall savings to the healthcare system.

Cytometrics plans to ship its first product, the *Hemoscan 1000*, to FDA-(Federal Drug Administration) regulated markets sometime this year. The expected cost of the unit is $5000 and about a dollar (the cost of the disposal probe shield) for each test

The American Red Cross is particularly interested in using the Hemoscan for screening blood donors. Currently, the ARC screens all donors for anemia prior to donation. This requires a needle prick of the finger or ear lobe. The Hemoscan would eliminate this needle stick to increase efficiency as well as decreasing discomfort and anxiety to donors.

The company is also developing the *Hemoscan 2000* which will provide a white blood cell count as well as measuring hemoglobin and hematocrit levels. The Hemoscan 2000 should be available commercially within two years.

The technique of viewing and mea-

FOR MORE INFORMATION

Cytometrics, Inc.
One Independence Mall
615 Chestnut Street, 17th Floor
Philadelphia, PA 19106
Web: www.cytometrics.com

suring micro-circulatory system underlying a mucous membrane has other applications beyond simple blood testing. This includes the diagnosis and treatment of shock, surgical transplants, cancer and infectious-disease cell detection, clinical chemistry, and veterinary medicine. For example, Cytometrics is currently developing Cytoscan, which could be used to observe blood flow in a variety of surgical and traumatic environments.—**Bill Siuru** PT

Raindrops Falling on Your Head

The world's largest atoll, part of the Republic of Marshall Islands in the Pacific Ocean, was recently the site of a two-month NASA-led experiment to improve weather forecasting and long-term climate modeling. In July, more than 200 participants traveled to the remote atoll, Kwajalein, a chain of coral islands that surrounds a 1000 square mile lagoon. Experts from NASA and other government agencies, including NOAA and the National Science Foundation; from universities and research institutions; and from Europe, Canada, Australia, and Asia participated.

The experiment, called KWAJEX, was part of a bigger NASA Tropical Rainfall Measuring Mission (TRMM). Researchers calibrated instruments on board the mission's TRMM satellite. Scientists throughout the world gathered detailed weather data that the satellite cannot obtain remotely—on the ground, by airplane, ship, and balloon. KWAJEX is the last of a series of experiments conducted as part of TRMM.

"NASA and the Japanese National Space Development Agency launched the TRMM satellite from which we'll get global precipitation measurements," said Steve Hipskind, Chief of the Atmospheric Chemistry and Dynamics Branch at NASA's Ames Research Center, Moffet Field, CA. "With its radar and microwave instruments, the satellite obtains a large-scale view of precipitation, but with less detail than many surface-based instruments. In contrast, ground and airborne measurements allow us to really understand the three-dimensional structure and evolution of tropical storm systems. Even without the satellite, these field experiments are leading to significant scientific progress in understanding precipitation processes."

TRMM Program Scientist Ramesh Kakar (NASA, Washington, DC) comments that though "very remote and logistically difficult, Kwajalein presents the ideal location for studying oceanic rainfall due to its location in the middle of the Pacific and its lack of any mountains or even hills that can cause their own small scale weather." By measuring tropical rainfall, researchers hope to have a better overall picture of how the Sun's energy, which is concentrated in the tropics, is transferred from the ocean to the atmosphere.

The goals of the experiment are to better understand the exact nature of oceanic rainfall and how it differs from the rain over land. Observations from TRMM revealed that thunderstorms tend to be much weaker over oceans. Differences in the clouds and possibly raindrops themselves must first be understood, before credible rainfall estimates can be made worldwide.

Three aircraft and a research vessel were also used during the experiment. The instrumented aircraft were the DC-8 "Flying Laboratory" from NASA Dryden Flight Research Center (Edwards, CA), a Cessna Citation II from the University of North Dakota, and a twin-engine Convair 580 from the University of Washington, Seattle. The DC-8 filled two roles: Firstly, it estimated satellite overpasses by flying above clouds with the same instruments that are aboard the TRMM satellite—radiometers and radar. Secondly, this plane also collected data from within clouds: It used cloud particle imagers and sampling equipment to measure the size of particles, as well as temperature, density, and motion within clouds. The newly commissioned NOAA research vessel, *The Ron Brown*, made additional observations, using meteorological Doppler radars on board and on Kwajalein to measure the three-dimensional motions of cloud droplets.

NASA Ames is responsible for KWAJEX project management and logistics. Ames has also managed three TRMM validation missions to Texas, Florida, and Brazil. Research goals include setting up long-term measuring stations at numerous locations around the world. TRMM is part of NASA's Earth Science Enterprise, a long-term research program designed to study the Earth's land, oceans, air, ice, and life as a total system, plus the effects of natural and human-induced changes on the global environment. PT

➤ Pattern Recogniton

Looking for a faster computer? How about an optical computer that processes data streams simultaneously and works with the speed of light?

In outer space, NASA researchers have been able to form optical "thin-films." By turning these thin-films into very fast optical computer components, scientists could improve various computer tasks, such as pattern recognition.

DR. HOSSIN ABDELDAYEM DEMONSTRATES a pattern-recognition setup that uses fast non-linear optical materials.

Dr. Hossin Abdeldayem, a physicist at NASA's Marshall Space Flight Center in Huntsville, AL , is working with lasers as part of an optical system for pattern recognition. These systems can be used for automated fingerprinting, photographic scanning, and the development of sophisticated artificial intelligence systems that can learn and evolve. PT

Caution—Trains Crossing!

On March 15, 1999, an Amtrak passenger train collided with a tractor-trailer truck loaded with heavy steel bars in Bourbonais, IL. Eleven people died and 120 were injured in that accident. In 1997, vehicle-train collisions caused 1020 crew injuries and 266 passenger injuries on Amtrak passenger trains alone. In addition, about 2000 motorists are seriously injured or killed each year at grade crossings, and such accidents cause tens of millions of dollars in property damage annually.

New technologies are under study by University of Illinois researchers trying to eliminate this kind of collision. The College of Engineering Railroad Program, which includes professors of both civil and environmental engineering and of electrical and computer engineering, is conducting research on how various applications of advanced technology—from fiber optics to steel cable barriers—can help improve grade-crossing safety.

THIS VEHICLE ARRESTING BARRIER is designed to stop even a speeding truck, using a net made of one-half inch steel cable that is lowered across a highway when a train approaches.

Professor Fred Coleman is evaluating alternatives to the familiar white-and-red crossing gate. One method is known as the Vehicle Arresting Barrier. Designed to stop even a speeding truck, the net is made of one-half inch steel cable that is lowered across a highway when a train approaches. Three test installations of this apparatus are in place on the Union Pacific line used by Amtrak trains between Chicago and St. Louis. Coleman and investigators for the Illinois Department of Transportation (IDOT) are testing their performance.

Another approach is to add a second set of gates at a grade crossing to prevent motorists from driving around the single gate on the right side. Coleman has completed an analysis of the proper design and operation of such a "four-quadrant gate," and he published his technical report this spring.

Alternative methods of warning drivers of an approaching train are also being studied, such as installing a device in highway vehicles similar to a speed radar detector. Professor Rahim Benekohal is studying a device to set off a flashing light or buzzer in the vehicle when a moving train is nearby. Benekohal and IDOT are also working on systems to improve the integration of roadway traffic signals with rail-crossing gates.

Also being studied is the use of fiber-optic technology to detect trains and measure their speed so that the grade-crossing systems can be better timed. Current technology relies mostly on electrical circuits running through the rail itself to detect an approaching train. Fiber optics might work by detecting the weight of an oncoming train. Professor Shun Lien Chuang is the lead researcher on this project.

In addition to IDOT, research on these new technologies has been funded by the Association of American Railroads (the trade association of major U.S. railroads) and the Transportation Research Board (an arm of the National Research Council). PT

ET—Phone Earth

Since Congress terminated NASA's Search for Extra-Terrestrial Intelligence program nearly six years ago, numerous grass-roots organizations have been keeping SETI science alive. SETI scientists are making microwave and optical measurements to determine whether humanity is alone in the universe. According to Dr. H. Paul Shuch, executive director of the nonprofit society, The SETI League, Inc., participation in SETI research by a wide range of dedicated amateurs is growing.

In a paper delivered at the Sixth International Bioastronomy Conference, Shuch argued that his colleagues in this area of research need to clearly and unambiguously define what constitutes interstellar contact. "Laymen have the time, energy, and enthusiasm to search in ways which the professional scientific community can not," stated Shuch. "However, there is valid concern as to whether those not schooled in the scientific method can do credible science. Premature announcement of an unverified contact especially could undermine the credibility and respectability not just of The SETI League's *Project Argus* search, but all of SETI experiments. Thus, one of The SETI League's duties is to educate its members in scientific restraint."

"The question (of proof) is complicated by the fact that the general public...may make only a vague distinction between proof and faith," Shuch's paper continues. "We must take pains to prevent such declarations of faith from clouding the judgment of our SETIzens."

Dr. Shuch added that there is a spectrum of view ranging from "Of course they exist—we couldn't possibly be alone!" to "I'll believe in the existence of intelligent extra-terrestrials only when one walks up and shakes my hand."

For further information, contact The SETI League, Inc.; Web: www.setileague.org; e-mail: join@setileague.org; Fax: 201-641-1771. The membership hotline is 800-TAU-SETI. PT

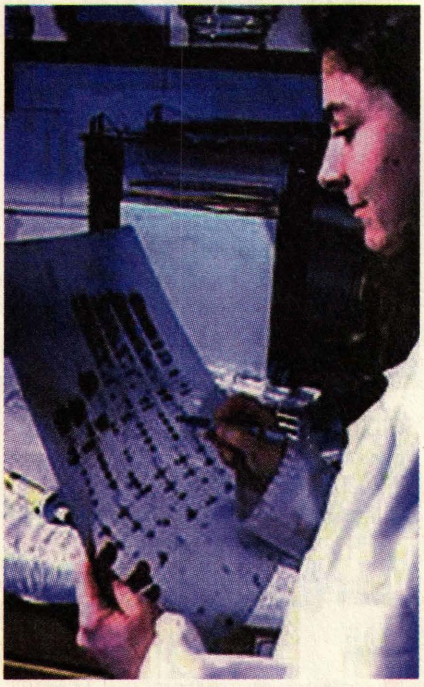
Charging Through DNA

A research team from the Georgia Institute of Technology has proposed an explanation for how electronic charge transfer occurs in strands of DNA. Researchers reported that electrical charge moves through the DNA bases by creating temporary distortions in their structure as the strands naturally flex. The work suggests that the charge transport process is much more complicated than previously believed.

"It's not at all like a conductor or a wire," said Dr. Gary Schuster, team leader and Dean of the school's College of Sciences. "When you inject a change

into DNA, the DNA responds by changing its structure to accommodate that charge. That change in structure distributes the charge over several of the base pairs in the DNA. That creates a local distortion in the DNA." It's like the movement of a "Slinky" toy—a large spring that compresses and expands, he explained. Schuster added that the local distortion, just like the Slinky toy's compression, can move in the DNA as the structure stretches, bends, and rotates.

The distortion, known as a polaron, can carry the charge a distance of up to a few hundred Angstroms. The charge transfer stops when it encounters a specific pairing of the DNA structure known as a GG step—the location where two guanine bases exist side-by-side. The charge trapped at this location



DR. VALERIE SARTOR EXAMINES DNA sequences in the laboratory at Georgia Institute of Technology. (Photo by Gary Meek. Used with permission of Georgia Institute of Technology.)

then oxidizes the guanine, causing damage that can lead to genetic mutations.

The new charge transport model, dubbed "phonon-assisted polaron-like hopping," could help scientists to better understand the mechanisms by which DNA is damaged and repaired and could also help them to develop a technique for reversing the damage done by oxidation. Natural biological processes repair much of the damage, but some damaged sections aren't repaired fast enough to avoid further damage and genetic mutations.

"It may be possible to intervene and accelerate the repair mechanism or inhibit the damage through pharmaceuticals or procedures," Schuster stated. "That would be important for certain people who have diseases in which the mechanisms for repairing DNA are inefficient."

An experiment conducted in Schuster's lab by Dr. Paul T. Henderson showed that the charge moves rapidly through a duplex strand of DNA with an efficiency independent of the base sequence. The structural independence and efficiency of the transport process were unexpected and could not be explained by existing theories of electron transport. Schuster believes two "averaging" mechanisms inherent in the polaron process tend to even out the speed of the charge transport, possible only because of the dynamic nature of the DNA structure.

Understanding how an electrical charge moves through DNA could also lead to new diagnostic techniques for identifying the DNA of disease-causing organisms or even to finding mutated copies of DNA. Also possible would be mesoscale micromachines that take advantage of the self-assembly capabilities of one-dimensional DNA "wires" and the enzymes available to control that assembly.

Far down the road, DNA offers advantages over the micromachining processes now being used. "DNA has the amazing ability to construct itself," Schuster noted. "Rather than having to build a machine atom by atom, you can take advantage of the ability of DNA to organize itself into complex structures. DNA comes in prefabricated parts that fit together, and that offers a tremendous advantage." PT

Behind the "Mask:" Next-Generation Technology

IBM and Photronics, Inc. recently announced joint activities to speed the development of new "mask" technologies needed to manufacture smaller, more complex semiconductors. "As the industry runs up against new chip manufacturing obstacles, we have to find more creative ways to work around them," said Michael Polcari, director, Silicon Technology and Advanced Semiconductor Technology Lab at IBM. "In this case, IBM has the technology and Photronics has the experience as a leading commercial mask supplier. Working together, we can help keep the industry moving forward."

The companies plan to make the mask technology commercially available to the semiconductor community, helping the chip industry keep pace with "Moore's Law." This is an industry axiom that predicts a doubling of chip performance every twelve to eighteen months. Such growth is necessary to meet the accelerating demands for computing power on the Internet, in all-pervasive computing devices, and in e-business.

Masks act like photographic negatives in a chip manufacturing process known as lithography, where tiny circuit patterns are printed on chips. The demand for better performance and increased function drives the industry to print millions of circuits on a single chip—pushing the limits of today's mask-making and lithography techniques. A number of improved or "next generation lithography" (NGL) processes are being explored. The development of accompanying mask technology could account for up to half of this cost and effort.

Since NGL manufacturing techniques are similar enough to permit crosscutting mask development efforts, IBM and Photronics are developing mask technologies that can be used with any NGL approach. The companies have established a "Mask Center of Competency," located at IBM's Burlington, VT manufacturing facility. Drawing on their experience, they will focus not only on mask development, but will also pursue related issues in the use of masks that affect the productivity of chip manufacturing. These issues include superior circuit image placement and critical dimension control. Photronics will manage the mask development projects and intends to make the masks commercially available. PT

Plug a Friend into
Electronics
NOW®
and Save $41.89*
This Christmas give an electrifying gift ... plug a friend into Electronics Now and brighten the whole new year! Whether electronics is your friend's livelihood or hobby, your gift will illuminate the whole spectrum of electronics throughout the coming year and provide a monthly reminder of your friendship.
Electronics Now will keep your friend informed and up-to-date with new ideas and innovations in all areas of electronics technology ... computers, video, radio, stereo, solid-state devices, satellite TV, medical electronics, communications, robotics, and much, much more.
We'll provide great plans and printed circuit patterns for great electronic projects. In just the last few years, Electronics Now has presented amateur TV equipment, robots, computer peripherals, microcontroller programmers, test equipment, audio amplifiers, telephone projects, relay circuits, and much more.
PLUS ... equipment troubleshooting techniques ... circuit design ... reports on new technology and products ... equipment test reports ... in-depth coverage on computers, video, audio, vintage radio ... and lots more exciting features and articles.
*Basic sub rate — 1 yr/$24.99 2 yrs/$48.99
SAVE $41.89* ... OR EVEN $83.78* ... For each gift of Electronics Now you give this Christmas, you save a full $41.89* off the newsstand price. And as a gift donor, you're entitled to start or extend your own subscription at the same Special Holiday Gift Rate—you save an additional $41.89*!
No need to send money ... if you prefer, we'll hold the bill till January, 2000. But you must rush the attached Gift Certificate to us to allow time to process your order and send a handsome gift announcement card, signed with your name, in time for Christmas.
So do it now ... take just a moment to fill in the names of a friend or two and mail the Gift Certificate to us in its attached, postage-paid reply envelope. That's all it takes to plug your friends into a whole year of exciting projects and new ideas in Electronics Now!

BY MARC ELLIS

Troubleshooting a Dead Receiver

APOLOGIES TO THOSE WAITING FOR THE OTHER SHOE TO DROP ON THE PHILCO 70 RESTORATION PROJECT. AS YOU KNOW, THE SET CAME TO LIFE AND PLAYED WELL AFTER ALL OF ITS BAKELITE BLOCK CAPACITORS WERE REBUILT, BUT IT STILL awaits cabinet refinishing and final touch-up alignment. Incidentally, does anyone know the whereabouts of a Philco alignment tool? I thought I had one in my tool kit until I needed it for the "70" project. Antique Electronic Supply shows one in their catalog but are out of stock until further notice.

The tool is nothing but a 1/4-inch hex-nut driver made of fiber or another non-conducting material. Metal doesn't work—especially in critical circuits such as the oscillator—because the metal influences the tuning. If you can provide one or know someone who can, write or e-mail your price—including shipping and handling. I've arranged to borrow one from a friend for the current project, but would definitely like to replace mine!

At the end of last year (September-November to be exact), I devoted three issues of my column (it was in **Popular Electronics** then) to a short series called "Radio Repair For Dummies." This was a radio-repair primer in which I reviewed the tools and resources that should be on the beginner's workbench; the basic cleaning, checking and housekeeping processes that can make the difference between an inoperative set and one that works when first plugged in; and the physical evidence that can lead the restorer to a faulty component. The last article in the series recommended the wholesale replacement of all paper and electrolytic capacitors in any radio undergoing a serious restoration. Suggestions were made on how to select and install the replacements.

Applying the simple suggestions in those three articles to your vintage set will give you excellent odds on coming up with a working radio without further troubleshooting. But, after all that, what if the set is dead as a doornail? In this column, we'll pick up where the original series left off and show you how to deal with a completely dead radio in a methodical manner.

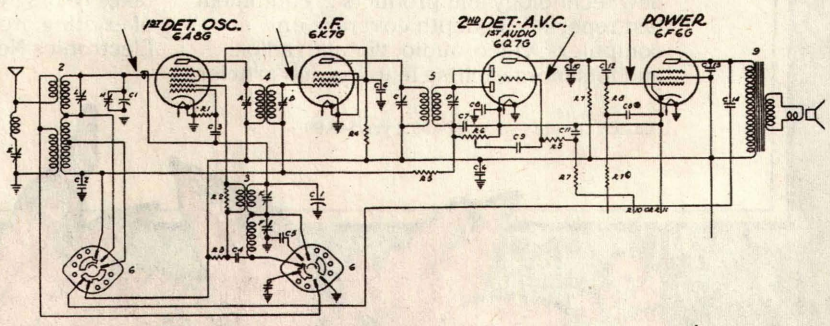
Click Your Way To The Trouble!

If you followed the start-up procedure in the October, 1998 column—which involved continuous monitoring of the set's plate voltage—you know the trouble probably does not lie in the power-supply circuitry. But where then do you look?

The simplest organized approach is sometimes called signal substitution or signal injection. And the simplest type of signal substitution does not require a single test instrument! All you need are your ears and a key or a small screwdriver. You should also have a copy of the schematic for your set. But before you start, review the safety procedures discussed in the September, 1998 column—particularly the material on AC/DC sets and isolation transformers.

This test method is quite crude, and the procedure I'm about to outline may not apply perfectly to every circuit variation you might encounter. However, it is something you can complete in just a few minute's time, requires only minimal technical skill, and will usually pinpoint the exact location of the circuit problem.

Turn the set on and advance the volume control all the way. Give the tubes a reasonable amount of time to warm up. Now hold the key or the metal screwdriver shaft in your hand and touch the tip to the control grid of the audio output tube (referring to your tube manual, the control grid will be the grid closest to the filament or cathode and might be labeled "G1"). The audio output tube is



THE ZENITH CHASSIS 5521 (shown without power supply) represents a simple superhet circuit you might encounter. The arrows show the "click test" points.

the one connected to your set's loudspeaker—usually through an output transformer.

Some larger sets have two audio-output tubes in push-pull or parallel. (Here's where having a circuit diagram on hand will be helpful.) If so, touch your key to the control grid of either tube.

If the audio-output stage is operating, you should hear a loud clicking, probably accompanied by humming. If no sound is heard, you've located the defective stage. But assuming that stage was fine, move back to the previous tube (usually the first audio amplifier) and touch the tip of your key to that tube's control grid. If there is a separate triode detector tube ahead of the first audio tube, test there also.

A few words of caution here! Sometimes, the control grid terminal is a convenient "grid cap" atop the tube. However, more often than not, it will be located on the tube base under the chassis, sometimes partially concealed by wiring. Check it carefully before touching it with the key or screwdriver!

There are high voltages on the leads to other tube elements such as the plate and (if present) screen grid. Actually, you may also find high voltage on the control grid if a preceding coupling capacitor is shorted. These will only be dangerous to you if another part of your body is touching chassis ground—so follow the old electrician's rule of keeping one hand in your pocket as you test!

Since tube-base terminal lugs can be very close together, you should also take care that the tip of your "test probe" does not short between adjoining ones. You could easily place a destructive high voltage in a circuit where it doesn't belong, thereby compounding your problem by frying other components!

Continue click-testing your way back through the receiver until you find a control grid that is silent. If the set is a superhet, you'll be working your way through the IF stage, or stages; the mixer stage (if the set has a separate oscillator tube), or the converter stage (if it doesn't); and—if present—the RF amplifier stage. If the set has a separate oscillator tube, do not include it in this test. By the way, the mixer or converter is often called "the first detector."

Finding the right grid to check on a converter or mixer stage can be confusing. However, with the help of your handy schematic you should be able to

Wavetek. The Way Value Is Measured.

For the best values in digital multimeters everyone is turning to the Wavetek XT Series. Each of these full-function DMMs measures voltage, current, resistance, and also a set of additional electrical or electronic properties you work with every day. Inductance. Capacitance. Frequency. Temperature. There is an XT Series DMM right for you.

With oversized character displays, these DMMs are as easy to read as they are to use. All have fully-fused current inputs and input warning beepers to protect you and the meter. Each comes with safety test leads and are approved to IEC1010-1 safety standards.

Our commitment to reliability and high quality is backed by the industry's only "No Hassle" warranty program. If your XT Series meter requires warranty service, your local dealer replaces it immediately. Call today for full details and the names of your local Wavetek distributors. You'll find that when it comes to Wavetek performance and price, nothing else measures up.

27XT *A unique combination of DMM and component checking in a single meter.*
- *Inductance*
- *Capacitance*
- *Logic*
- *Frequency*

23XT *Electronic and electrical test functions for general duty and HVAC/R.*
- *VAC Safety Tester™*
- *Temperature*
- *Transistor*
- *Logic*

25XT *A full C-meter in a DMM, and more! Ideal for AV, cell-phone & antenna matching, component inspection.*
- *Full Capacitance 0.1pF to 20mF*
- *Capacitance Zeroing & Test Slots*

28XT *A thermometer + DMM for HVAC/R, building or plant maintenance.*
- *Temperature*
- *Capacitance*
- *Frequency*
- *Max-Hold*

85XT *A precision True-RMS reading DMM, ideal for equipment like copiers.*
- *4 1/2 digit*
- *0.05% Accuracy*
- *True-RMS*
- *Frequency*
- *Duty Cycle*

LCR55 *Full-function LCR, extra test features for "best-buy" in a component checker.*
- *Inductance*
- *Capacitance*
- *Resistance*
- *Transistor*
- *Dual Diode*

Accessories include current clamps, RF & HV probes, temperature converters, holsters, boots and carrying cases.

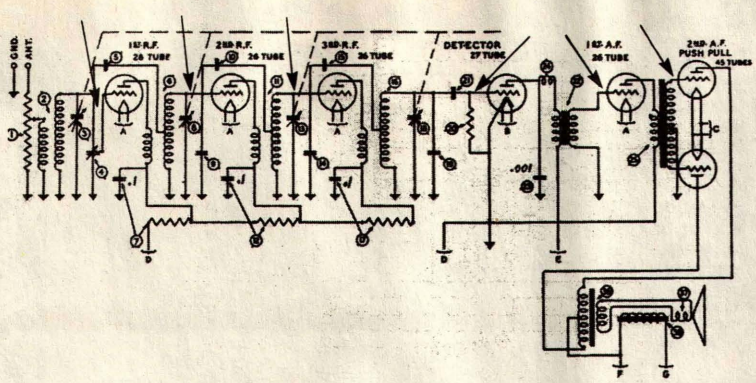
FREE HOLSTER when you buy now*

CIRCLE 170 ON FREE INFORMATION CARD

Wavetek Wandel Goltermann
9145 Balboa Avenue, San Diego, CA 92123
(800) 854 2708 • www.wavetek.com

*Limited time offer. Contact Wavetek or local distributor for details

WAVETEK



THE PHILCO 87 TRF uses a simpler circuit than the Zenith superhet example, but also uses more tubes. Note the three RF amplifiers, separate detector, and push-pull audio output. Again, the arrows show "click test" points.

locate the grid that receives the output of the RF amplifier tube (if it is present) or the set's antenna tuning circuit (if it is not).

If the set is a TRF (tuned radio frequency) model, things are simpler. There is no converter, mixer, or oscillator stage to worry about. After working your way back past the first audio amplifier, you'll pass through two or more RF amplifier stages before reaching the antenna-tuning circuit.

With the click testing completed, the trouble is now isolated between the circuit points where the click was last heard and where the click disappeared. This is a very small portion of the radio's circuitry, and it will, therefore, be easy to check for defective components or other difficulties.

Did you get through the entire procedure without finding any "silent" control grids? If so, your trouble may be in the set's oscillator stage or the oscillator section of its combined oscillator/mixer. Check the voltages on that stage according to the methods outlined in the section that follows.

Finding The Problem

Once again, we'll be outlining a very crude procedure that will be successful in a majority of cases, but will not deal with more subtle problems. As with most of the procedures I talk about in this column, I try to speak to folks who are newcomers to the hobby and as yet have limited experience. But keep in mind that it isn't rare for a problem to elude even the most advanced serviceman. Back in the days when radio servicing was a common business, reams of print were generated by authors advising technicians on how to deal with "tough dog" problems.

The first and most obvious thing to do is to observe if the tube where the trouble is localized is lit. If it is a glass tube, a simple glance will tell you. If it is a metal tube or a glass one encased in a tight-fitting tube shield, check for proper voltage (refer to your tube manual) at the tube's filament pins. Remember to use the AC ranges of your multimeter unless you are working with a battery-operated set. If there is no voltage (unlikely if the other tubes are lit), you need to trace the filament wiring to find out why. If there is voltage, remove the tube and use your ohmmeter function to make sure that there is continuity at the tube's filament pins.

If the tube is lit, you should next check to see if its plate and screen grid are receiving the DC voltages they need for proper operation. Don't worry about the exact readings unless you have service data telling you what to expect at each tube pin. This is just a crude check, but you can expect to see voltages of over 200 at the plate, somewhat less on the screen grid. If the set is an AC/DC model (no power transformer), voltages will be proportionately lower. Also check the voltage on the control grid. There should be no measurable amount using an ordinary multimeter.

If you find something amiss with the voltages, study your schematic to see if you can deduce the reason. You will want to look at capacitors, resistors, and any IF or audio transformers. First check the capacitors and resistors for obvious signs of charring or overheating. The bulk of radio failures are caused by a shorted capacitor—which then puts high voltage on a circuit point where it should not be, possibly destroying other components.

See if you can figure out which capacitor would, if leaky or shorted, cause the voltage anomaly you found. (Of course—gentle hint—if you'd replaced all the caps before turning on the set you wouldn't be dealing with this problem now!) If there is a likely candidate, you'll need to check it with your ohmmeter—temporarily disconnecting one end to isolate the unit from the set's circuitry. After an initial "kick" caused by the charging of the cap from your ohmmeter battery, there should be virtually no resistance reading at even the highest range of your meter.

Was the cap the problem? If so, check the associated component that also probably failed—perhaps a resistor or an IF or audio-transformer primary winding. Use a heavy helping of common sense to spot the probable failure. At this level, troubleshooting is not rocket science! Use your ohmmeter to check the suspect resistor(s) for the proper value and the winding for continuity. You'll probably have to disconnect one end of each suspect resistor to isolate it for checking. Chances are you'll be able to check the transformers as wired because one end is connected only to the tube plate and not to any other circuitry.

If all voltages and components seem OK, you'll want to see if there are any gaps in the path of the signal passing through the set. Once again, don't feel intimidated even if your experience is limited. Use common sense and logic! A typical problem is an open circuit in the coupling capacitor between the first and second audio stages or (older sets) in the secondary of the coupling transformer. A less common one would be an open IF-transformer secondary winding. Such failures probably would cause no detectable anomalies in your voltage readings. Check for the open cap by bridging a known good one across it. Check for an open winding with your ohmmeter. There's usually no need to remove it from the circuit first.

I hope this short course in fixing inoperative receivers will help you solve most of your problems! Let me hear about your servicing experiences. Write me at "Antique Radio," c/o **Electronics Now**, 500 Bi-County Blvd., Farmingdale, NY 11735. You can also contact me via my personal e-mail address: ellis@eneteract.com. Regretfully, time limitations do not always permit me to respond individually. EN

We're Hanging Out Your Shingle...

. . . that is, if you're a NESDA member. Through our Internet Referral Program, consumers are able to find NESDA Quality Servicers in their area.

But that's not all! NESDA offers technical and management seminars, group insurance and more. Stay in touch with other servicers through NESDAnet e-mail networking. It's a great way to find hard-to-get parts, or ideas on that repair job that won' t go away. For more information — ***lots of information*** — just call. We're here to help your business.

National Electronics Service
NESDA
Dealers Association, Inc.

Making a Diff erence for You.

For a complete list of benefits, contact NESDA at 2708 W. Berry St., Ft. Worth TX 76109; 817-921-9061; www .nesda.com.

BY DON JENSEN

Weird Antennas of Yesteryear

LAST MONTH, WE LOOKED AT THE START OF SHORTWAVE BROADCASTING, AND SHORTWAVE LISTENING, SOME 70 YEARS AGO. IN THE EARLY DAYS OF SHORTWAVE LISTENING, EVERYTHING WAS NEW, INCLUDING THE TECHNOLOGY. IF there were no known truths, any "truth" seemed worth trying. Experimentation—some of it pretty silly in today's light—was the name of the game for pioneer SWLs. Nowhere was that more evident than in the design of antennas.

The most popular receiving antenna, then as now, was the longwire. But, as Jerome S. Berg points out in his new history of international broadcasting, *On The Shortwaves, 1923-1945* (McFarland & Co., Inc., Publishers) "various oddball alternatives were available as well...."

For example, there was the Dubilier Light Socket Aerial—"The static is about gone, interference is reduced, and you've done away entirely with sooty aerials, lead-in wires, ground switches. and lightning arresters."

Others included the Yahr-Lange Super Ball Antenna—"Greater selectivity, volume and distance due to its conductive surface of 364 square inches." Or the Rogers Underground Antenna—"Dig a small hole in the ground outside a window near your set, drop the Rogers Underground Antenna in the hole, cover it over with dirt...and tune in on loud, clear, steady reception!"

Foolish as some of these sound, goofy antennas were still being touted by some would-be experimenters decades later. I recall reading an article in the 1960s proposing that a lead-in wire be clipped to the bedspring, using the bed as a homebrew SW antenna. And, in the 1970s, someone suggested running a roll of aluminum foil around the room, gluing it down, then wallpapering over it to make an "invisible antenna." Some of these gizmos may have been better than no antenna at all ... but not much better!

Proper grounding of the receiver also got a lot of attention in the early years of DXing. Berg quotes pioneer listener Carleton Lord's tongue-in-cheek "recollections" on the subject of good grounds:

"There was little magic in the common cold water pipe, but consider what you could do with a 6 foot copper-plated stainless steel rod, an old auto radiator, or

THE LATE ARNE SKOOG, in a 1960s photo, tuning his SW receivers. Skoog, who died in June, was the editor of "Sweden Calling DXers," a popular program for SW listeners aired for well over three decades by Radio Sweden.

a 40 gallon water tank. Burying such contraptions was not enough; you were supposed to dig a full-sized grave away from the light of the full moon, drop a tea kettle to the bottom, fill the pit with a proper mixture of gravel, rock salt, peat moss, Vigoro and top soil, then hook up an automatic sprinkler system to moisten the filled pit for three hours before you turned a dial. Then you also had the U.S. Standard ground, the Ollie Ross (renowned early listener) Ground, the inverse counterpoise, and many others."

"One DXer," Lord claimed, "buried 100 feet of trolley wire in a 3 foot deep trench that circled a spring, and another night-owl (listener) tossed 500 feet of wire into the Pacific Ocean."

Farewell, Arne Skoog

For three decades, from 1948 to 1978, Arne Skoog was the moving force behind "Sweden Calling DXers," Radio Sweden's pioneer program for SWLs. Though more than 20 years have passed since he retired, many longtime shortwave listeners fondly remember him as one—perhaps the most—important reason why they got started in this hobby.

Arne Skoog died June 7, at the age of 86.

Skoog was a 35-year-old engineer at Radio Sweden when he inaugurated "Sweden Calling DXers" as a way of keeping shortwave listeners in touch with what was happening in international radio.

As SW historian Jerry Berg says, "You always hoped that Tuesday night reception from Sweden would not be too 'watery' (which it often was) because that was SCDX night."

The 10-minute program, largely the latest tips on what to tune, where, and when, was followed up with a printed version of the program, which was airmailed free to any listeners who requested it.

At its peak, there were between 1500 and 2000 SWLs worldwide on the station's mailing list for this program summary. Skoog and his program introduced countless casual listeners to the SWLing hobby.

After his death, early in the summer, many of them wrote to the station to

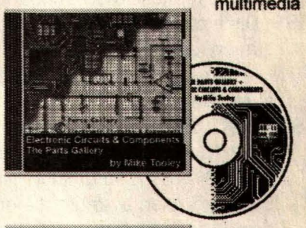
CREDITS: Brian Alexander, PA; Ralph Brandi, NJ; Jeff Findlater, CA; Mark Humenyk, ONT; David Krause, OH; Jerry Lineback, NE; Jim Moats, OH; Don Nelson, OR; Ed Newbury, NE; Chuck Rippel, VA; North American SW Association, 45 Wildflower Road, Levittown, PA 19057.

Electronics CD ROMs

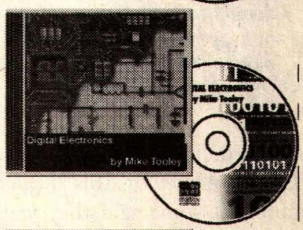
produced by: matrix multimedia

Want to improve your design skills?

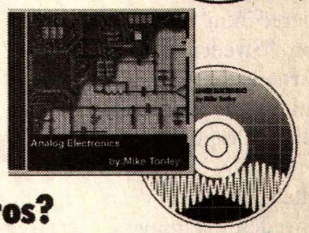
Then you should consider our range of CD ROMs by best-selling author **Mike Tooley**.



Electronic Circuits and Components provides a sound introduction to the principles and applications of the most common types of electronic components and how they are used to form complete circuits. Sections on the disc include: fundamental electronic theory, active components, passive components, analog circuits and digital circuits. Includes circuit s and assignments for Electronics Workbench.



The Parts Gallery has been designed to overcome the problem of component and symbol recognition. The CD ROM will help students recognize common electronic components and their corresponding symbols in circuit diagrams. Quizzes are included. The Parts Gallery is free with Electronic Circuits and Components.



Digital Electronics details the principles and practice of digital electronics, including logic gates, combinational and sequential logic circuits, clocks, counters, shift registers, and displays. The CD ROM also provides an introduction to microprocessor-based systems. Includes circuit s and assignments for Electronics Workbench.

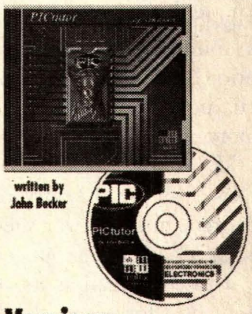
Analog Electronics is a complete learning resource for this most difficult subject. The CD ROM includes the usual wealth of virtual laboratories as well as an electronic circuit simulator with over 50 pre-designed analog circuits, which gives you the ultimate learning tool. The CD ROM provides comprehensive coverage of analog fundamentals, transistor circuit design, op-amps, filters, oscillators, and other analog systems.

"...hammers home the concepts in a way that no textbook ever could."
Electronics Australia

Interested in programming PIC micros?

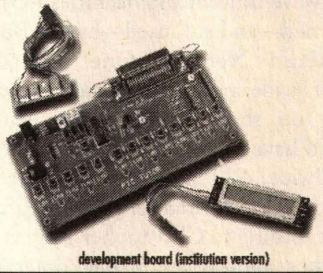
We have the perfect solution:

Our PICtutor CD ROM can teach you how to write assembly language programs for the PIC series of microcontrollers. The CD ROM's 39 tutorial sections will guide you from basic PIC architecture, commands, and programming techniques up to advanced concepts such as watchdog timers, interrupts, sleep modes, and EEPROM data memory use. Over 80 exercises and challenges are provided to test your understanding, and the unique Virtual PIC allows you to write and test programs on-screen.



written by John Becker

The complementary development kit includes a reprogrammable PIC16C84, which you can program via your printer port. The institution version (designed for use in schools, colleges and industry) includes a quad 7-segment LED display and alphanumeric LCD display. The development kit provides an excellent platform for both learning PIC programming and for further project/development work. Assembler and send (via printer port) software is included on the CD ROM.



development board (institution version)

Prices and Versions

Institution versions are suitable for use in schools, colleges and industry. Student versions are for student/home use.

	student version	institution version
Electronic Circuits & Components	$56	$159
Digital Electronics	$75	$189
Analog Electronics	$75	$189
PICtutor (CD and development board)	$179	$350

Shipping costs to Canada an additional $5. Overseas orders please contact CLAGGK Inc. for shipping costs.

see http://www.MatrixMultimedia.co.uk for full specs and demos

Order Form

Please circle the products you would like to buy on the table above right, calculate the total cost, fill in the form below and send it to us. Please allow 4 - 6 weeks for delivery.

Name: _____

Address: _____

_____

Zip: _____ Telephone: _____

I have enclosed my check for $: _____

Please charge my credit card for $: _____

Note that the delivery address and the address at which the card is registered must be the same.

Signature: _____

Number: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐

Card type: _____

Mastercard, Visa, or Discover only

Expire date: ☐☐ ☐☐

CL02

Claggk Inc., PO Box 4099, Farmingdale, NY 11735-0792
Tel: 516-293-3751 email claggk@poptronix.com

ABBREVATIONS

DX, DXing, DXer = Distant shortwave stations; listening to them as a hobby; one who hunts DX radio signals.
ID = Voice identification announcement.
IS = Distinctive interval signal used as a station identifier.
kHz = kilohertz, unit of frequency measurement.
SW, SWL, SWLing = Shortwave; shortwave listener, shortwave listening.
UTC = Universal Coordinated Time, a standard used by most major international broadcasters and listeners. It is equivalent to Eastern Standard Time plus 5 hours; CST+6; MST+7 or PST+8.

express their condolences. So strong was Skoog's impact on this influential program that some said they well remembered him reading those listening tips on "Sweden Calling DXers." In fact, Arne gathered much of the information and wrote the detailed scripts, but various colleagues read them on the air.

SCDX was aired first in English, then, in later years, in all of Radio Sweden's language services—except, ironically, Swedish. Skoog also was one of the founders of the Swedish DX Federation, and later, the European DX Council, both organizations dedicated to supporting SWL clubs in that part of the world.

On the 30th anniversary of SCDX, Arne retired, turning over the program to a young American announcer, George Wood, who continued as its editor and on-the-air host for years.

But changing times and new Radio Sweden management led to a shifting emphasis. The mailing list was discontinued and SCDX became a twice a month English-only program called MediaScan.

MediaScan can be heard every other Tuesday at 1130 UTC on 18,960 and 21,810 kHz; at 1330 UTC on 15,240 kHz; at 0230 UTC (Wed.) on 9495 kHz, and 0330 UTC (Wed.) on 9495 and 12,060 kHz.

The old SWDX program of SW listening tips, however, gave way to a new format, focusing on satellite broadcasts, computers, and general Scandinavian media news. Although in retirement, Skoog expressed his disapproval of this change in focus, but to no avail. In his later years, he concentrated his attention on his second hobby of violin making.

Merlin's Magic Act

Just when we were getting used to the fact that the BBC wasn't the only international broadcasting voice from the United Kingdom, Merlin Network One pulled a vanishing act. MNO cut its worldwide SW presence from a wall-to-wall 24 hours a day to just one hour daily, five days a week, a few months ago. And that single hour, 1600 to 1700 UTC, is aired on 6175 kHz, when it's not likely to be heard well in North America.

MNO is the programming arm of Merlin Communications, the British company that now owns the privatized shortwave transmitting facilities formerly owned—and still used—by the BBC.

Merlin Network One offered a rather wide range of music programming on shortwave that, it seemed, should have earned it a decent audience worldwide. All that is left on SW at this writing is a recorded religious program.

According to Christopher England—a rather appropriate name, don't you think—of Merlin Communications International, the MNO broadcasts on shortwave were intended as a programming research experiment to determine SW listening patterns. In the future, England says, this collected data on who's listening and where will be used to help clients interested in reaching specific geographical targets via shortwave. In other words, look for Merlin to become like the handful of US commercial shortwavers and others who sell airtime to religious, political, and ideological groups for their canned programs.

Down The Dial

Here's our monthly list of interesting things to tune on shortwave:

ALASKA—9615 kHz, KNLS is heard here in English at 1329 UTC, with ID, short features, and a religious talk. The signal is subject to fading.

BELARUS—7210 kHz, Radio Minsk broadcasts in English around 0200 UTC, with news, commentary, and identification.

GUINEA—7125 kHz, RTV Guineene is a West African SW outlet that signs on just before 0600 UTC, with guitar IS, French ID, and news.

GUYANA—5950 kHz, Guyana Broadcasting Corp. is in Guyana, a South American country—not to be confused with Guinea—which has a sizable population whose ethnic origins are in India. So its not surprising that musical programming includes Hindi vocals. Look for this one from before 0900 UTC.

ITALY—11,900 kHz, RAI in Rome noted around 2220 UTC with a variety of music, from ballads to jazz. It operates in parallel on 9675 kHz.

MONGOLIA—12,015 kHz, Voice of Mongolia is heard here at 1200 UTC, with its tuning signal and English ID, and then an English newscast.

NIGER—5020 kHz, La Voix du Sahel broadcasts from Niger; and yes, it is Niger, not Nigeria, which is a different West African country. Listen around 0430 UTC for African music and French language announcements.

PAKISTAN—17,895 kHz, Radio Pakistan is heard with English news, read very slowly, from 0230 to 0244 UTC. It signs off quite abruptly a minute later. This one operates in parallel on 15,485 kHz.

PAPUA NEW GUINEA—4890 kHz, National Broadcasting Co. is heard on this frequency around 1000 UTC, with English news and commentary. By 1045 UTC, programming is in one of the local pidgin languages.

PHILIPPINES—15,190 kHz, Radio Pilipinas has English from 1800 to sign off at 1930 UTC. Programming is mostly music, with occasional IDs. It also uses 17,720 kHz at the same time.

SEYCHELLES—9770 kHz, British Broadcasting Corp. World Service is relayed from this transmitter site in the Indian Ocean. It has been reported here at 0225 UTC, in English, of course, with talks, stock market news, program preview, and the "World of Music" program. EN

CABLE BOXES
BEST PRICES
Ship Anywhere In U.S.A.
1-800-637-4615
www.xxbox.com

BY KONSTANTINOS KARAGIANNIS
COMPUTER EDITOR

Buyer Beware

SEEN ANY RIDICULOUSLY LOW PRICES ON NEW COMPUTERS LATELY? THAT IS, WHILE THE BIG BOYS (NATIONAL CHAINS AND DIRECT DEALERS) ARE SELLING PENTIUM III SYSTEMS PRICED IN THE $1500 AND UP RANGE, IN THE NEW YORK AREA AND elsewhere, many local ads for PIII systems in the $700 to $900 range are popping up. One of these catch your eye?

They sure caught mine. These ads are in most every newspaper and tempt quite a few consumers. I recently decided to find out just how these stores could afford to offer such allegedly hot systems at closeout prices. Something about these bargain PIII deals seemed a little too good to be true, and sure enough, that was the case. These machines turned out to be empty promises from less-than-honest vendors.

You won't believe what these con artists are up to. Read on to make sure you're not made a victim next time you go computer shopping.

Selective Truthtelling

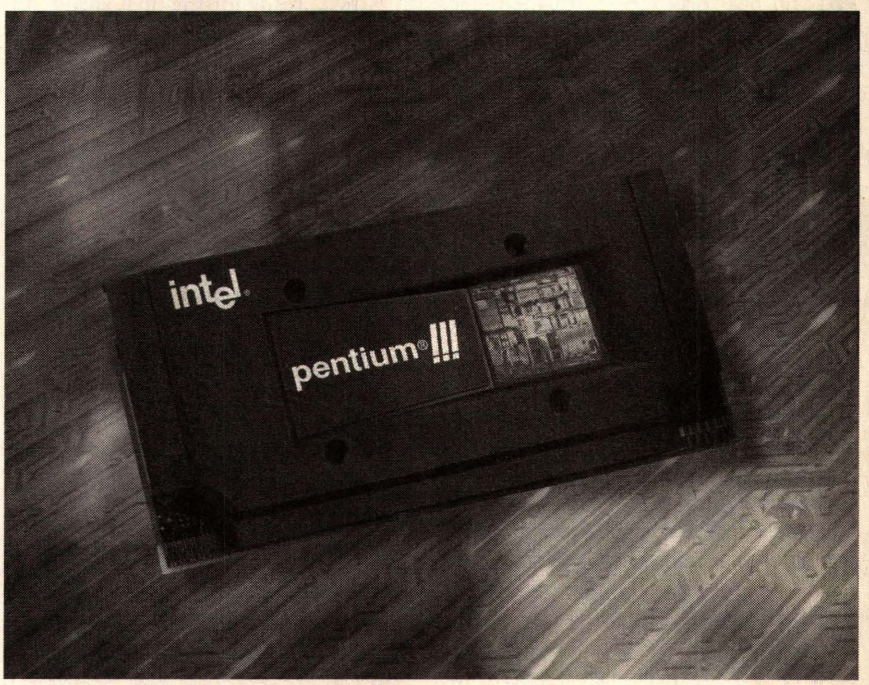
Most every kid in the world has gotten into an argument about semantics with Mom and Dad when it comes to lying. Parents will claim that not telling the whole truth is just as bad as lying, while the child being "charged" with the offense will stick to the notion that leaving out certain details is not the same thing as fibbing. Take whichever stance on this issue that you want, but when it comes to the world of retail, holding back certain details is downright low.

If you have an ad handy that seems to match the too-good-to-be-true criteria, read it carefully. Perhaps it claims a PIII 450 processor, 128MB of RAM, a 6.4GB hard drive, and a 17-inch monitor, all for, maybe, $800. To drive the phenomenal nature of the offer home, the system may be labeled with a name brand, say IBM or Compaq. Wow, what a deal!

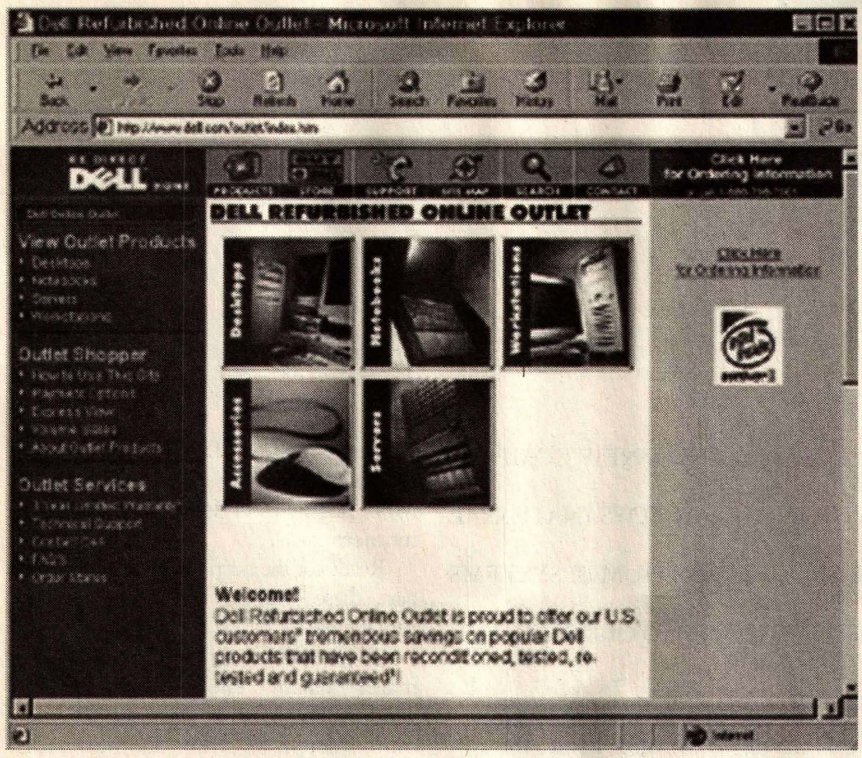
Think about the specs you just read for a minute. What's missing? As for the processor, a chip's a chip. If it says PIII, then it's a PIII. Fine, but does a 450-MHz processor always run at 450 MHz? No. You may know that the clock speed of a CPU is dependent on a multiplier of the system bus. A PIII 450 is designed to run at 4.5 times the speed of the 100-MHz bus in Intel 440BX or equivalent motherboards.

Ready for the horrid truth? For the most part, these "bargain" machines are *NOT* running on 100-MHz motherboards!

To assemble such a dream (nightmare?) machine cheaply, these crooked vendors are putting Pentium III chips on outdated 66-MHz motherboards. The result is a crippled PIII, with a relative performance just under that of a Pentium *II* at 300 MHz. As a result of the slow motherboard, the system memory is limiting, too. As these older boards use 66-MHz RAM, the boosts gained by PC-100 SDRAM memory are lost. Cheap and slow 66-MHz memory, often EDO DRAM, is used instead.



AMONG THE SHIFTIER COMPUTER DEALERS, Intel's Pentium III processor may be the most misused CPU ever—read our tips this month for avoiding a bum deal.



FOR A GOOD-QUALITY REFURBISHED or bargain machine, check out Dell's Outlet online.

Again, these are details that are left out. The memory is listed by amount only, and the processor according to its "labeled" clock speed.

So right off the bat, you have a machine that will likely be buggy (the PIII will not "play nice" with the older chipset used in the inferior motherboards), and much slower than you'd expect from the newest class of Intel chip.

But it keeps on getting worse. The hard drive could have a horrifically slow access speed and may be a refurbished unit. The 17-inch monitor will likely turn out to be a 0.39-mm(!) pitch unit—practically a step above one of those old-fashioned Lite-Brite toys when it comes to graininess. In one case, I asked one of these shifty vendors how much it would cost to upgrade from such a terrible display to a .28-mm *15* inch monitor, and he said quite calmly that it would be $69. Think about the ramifications of having to pay to upgrade to a smaller monitor.

We've looked at the misrepresented facets of a typical bargain system so far. But what about the details you never even read of? Expect such a system to have a 16X or 20X CD-ROM (a $5 item nowadays). Count on the video to be a mere 1MB integrated system (capable of displaying only 256 colors at a decent resolution and incapable of playing most modern games). And the modem? If the system has one, it will likely be of the quality that should disconnect you about every ten minutes or so.

Now ... ready for the final kicker? In these "bargain" systems, many of the parts just described, as undesirable as they are, are not even new! That's right, to add insult to quality-injury, many components being used in these machines are refurbished or repaired, being salvaged from older PCs. However, because these parts and motherboard were once used in, say, an IBM machine and are now contained in a new (or relatively new) case from the same manufacturer, the computer can be sold as an IBM. Of course, the dealer couldn't put a model number on the machine, because that really would be fraud. For this reason, the too-good-to-be-true ads just say the company name, only adding to the appeal of the system.

Know what you're buying. Ask what components are really in the system. Be wary of dealers who won't let you look inside. One such dealer had the nerve to tell me he wouldn't even let me look at the back of the case, let alone inside. Nice, huh? Would you buy a computer from such a shifty salesperson with so much to hide? I don't think so. There are enough reputable places to shop—stick to them.

SOME WEB SITES OFFERING RELIABLE REFURBISHED MACHINES

DAMARK International
Web: www.damark.com
Great prices on refurbished name-brand computers, as well as numerous other gadgets and gizmos.

Dell
Web: www.dell.com/outlet/index.htm
Contains some of the most cutting-edge refurbished deals around.

Egghead
Web: www.egghead.com
Click on "liquidation & refurbished" to search their changing selection.

IBM
Web: refurbishedpcs.financing.ibm.com
While some machines may be a bit old, the prices are worth checking.

Refurbished Is Not Always A Dirty Word

For the sake of fairness, it is important to point out that not all systems in the refurbished category are bad buys. Many companies, direct-marketing-giant Dell and IBM included, have extensive selections of refurbished machines at great prices. In most cases, these were just returned because buyers decided they couldn't pay for them, or because one component was faulty and replaced. Dell's refurbished buys even have the same warranty that a new system would have, giving you a safe way to save some money.

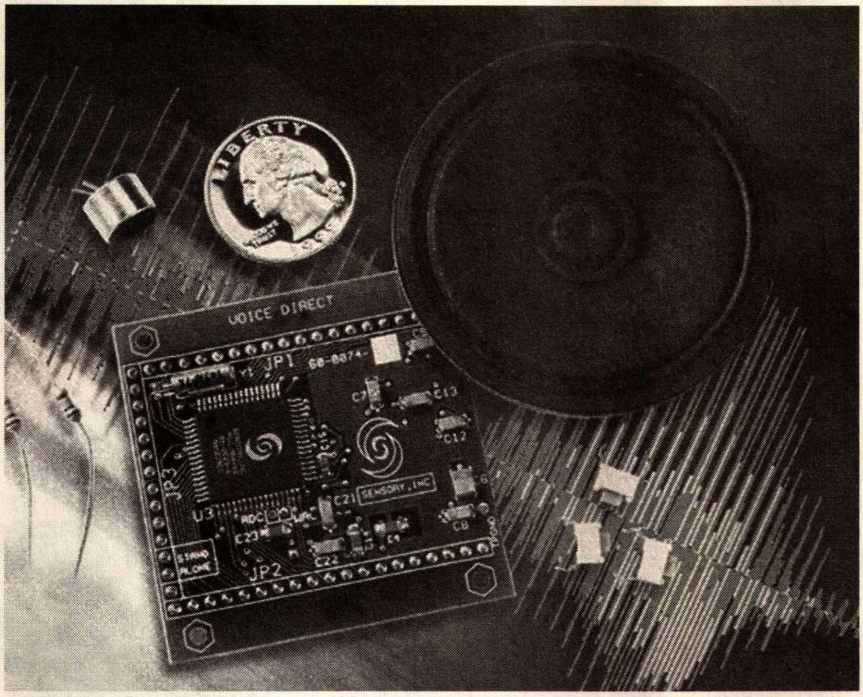
You may even be able to save money by buying a refurbished PC through an independent distributor. Just make certain of two things when doing so. For one, check that the system in question has its original specifications. That is, buy a Compaq model XYZ, but not a system just referred to as a refurbished Compaq. Second, be sure that your refurbished system comes with a warranty. Saving $300 or so isn't a great idea if it will mean twice as much in parts replacement and labor down the road.

That about wraps it up for this month. If you'd like to get in touch, you can send e-mail to connections@gernsback.com or snail-mail to Computer Connections, **Electronics Now**, 500 Bi-County Blvd., Farmingdale, NY 11735. EN

NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Speech Recognition Kit



CIRCLE 338 ON FREE INFORMATION CARD

THE VOICE DIRECT SPEECH RECognition Kit is an ideal development tool to apply speech recognition to everyday household electronics. With Voice Direct, items like TV remote controls, alarm clocks, microwaves, toys, motors, telephones, and numerous other common household appliances can come to life using voice commands.

The kit can support slave-mode operation for developers who want to customize their applications. It is a development tool designed for anyone from high-school students and beyond to electronic hobbyists to engineers. Using a speaker-dependent (user-trained) speech-recognition module, the unit can learn to recognize up to 15 words or phrases in any language that lasts up to 3.2 seconds. The module is powered by the Voice Direct speech-recognition processor.

The speech-recognition kit comes complete with the assembled Voice Direct module (which contains a microphone pre-amplifier, serial EEPROM, and oscillator), a microphone element, speaker, (3) microswitches, (2) 100k resistors, and a quick setup guide. A 5-volt (±10%)/50mA power source, hookup wire, 0.1-inch headers, and 3- by 3-inch prototyping board are needed for installation.

The Voice Direct Speech Recognition Kit has a suggested retail price of $49.95.

SENSORY, INC.
521 East Wendell Street
Sunnydale, CA 94089-2164
Tel: 408-744-9000
Fax: 408-744-1299
Web: www.SensoryInc.com

Smart Automobile Compass

DESIGNED TO GIVE DRIVERS essential trip information, the V5000 Series Multi-Sensor Vehicle Compasses use state-of-the-art sensor technology to provide a variety of readouts: directional and altimeter readings, digital clock, automatic trip timer, trip logs, inside and outside temperatures, and black-ice warnings. All three V5000 units come standard with a large digital compass LCD readout that displays both numeric and cardinal points, have a back-light for easy viewing at night, and feature simple electronic calibration. The compasses also include "SMART" sensor features, such as an auto shut-off when the car is not in use for ten minutes, magnetic distortion detection and correction elements that tell when the compass reading may be affected by an outside source, and a multiple trip log that stores information for up to three trips.

CIRCLE 339 ON FREE INFORMATION CARD

Each V5000 Series compass comes with a fully adjustable mounting bracket that rotates 180 degrees and can be attached with heavy-duty suction cups. The compasses operate on two AAA batteries for over 250 hours or with an optional 12-volt lighter adapter power cord (standard in some models).

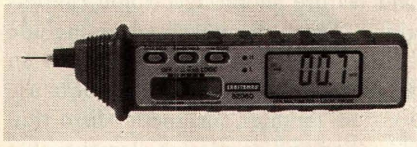
The suggested retail prices range from $79.95 for the V5000 basic model to $129.95 for the fully-loaded V5000TA.

PRECISION NAVIGATION, INC.
5550 Skylane Blvd., Ste. E
Santa Rosa, CA 95403
Tel: 707-566-2260
Fax: 707-566-2261
Web: www.precisionnav.com

Pen Multimeter

IDEAL FOR TROUBLESHOOTING logic and general AC/DC circuits, the

Craftsman Pen Multimeter with Logic Test is an autoranging DMM with Data Hold and Range Hold functions. Among its other functions are DC and AC voltage up to 500 volts, DC and AC current, resistance, logic test for indicating digital threshold levels, and audible continuity and diode tests. The pen point makes it easy to touch component leads, PC board traces, tie points, IC points, and other small devices. The safety probe tips can be stored when not in use.



CIRCLE 340 ON FREE INFORMATION CARD

Measurements are displayed on a large, 3200-count, high-contrast LCD with bargraph. Auto power off, and overload- and low-battery-indication are also featured. The Pen Multimeter with Logic Test includes case, extra fuses, manual, and test lead with alligator clip.

The Craftsman Pen Multimeter with Logic Test has a list price of $44.99.

SEARS ROEBUCK, INC.
Tel: 800-390-8792 (information) or 800-377-7414 (sales)

Electro-Optical Adapter

THE NU-VIEW SX-2000 IS AN ELECtro-optical adapter that when attached to practically any camcorder, produces stereoscopic three-dimensional (S3D) video recordings. A threaded optical adapter is first attached to the camcorder's filter threads, providing a stable optically aligned bayonet mount. Once it's attached to the camcorder, the auto focus, auto exposure, zoom, and white balance camera functions are performed as usual.

CIRCLE 341 ON FREE INFORMATION CARD

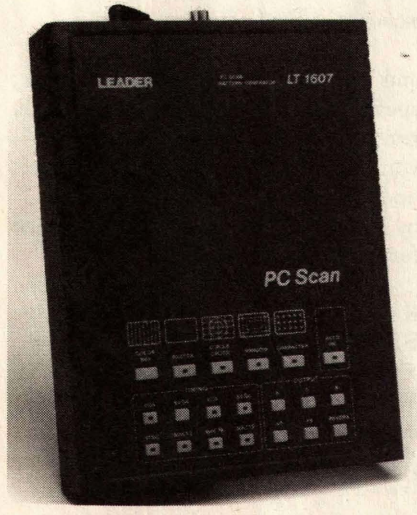
After they are connected together, the camcorder is used in a normal manner to view and record. A simple, single convergence control allows the user to converge on objects near or far, and the Stereo-Optix technology provides the camcorder with the needed parallax view to create a true stereoscopic image. Best of all, 3-D content can be viewed on a standard TV.

The Nu-View SX-2000 elctro-optical adapter has a suggested retail price of $399.95.

3-D VIDEO, INC.
418 Chapala Street
Santa Barbara, CA 93101
Tel: 888-883-3843 or 805-963-5990
Fax: 805-963-9770
Web: www.3-dvideo.com

Pattern Generator

THE PORTABLE PC SCAN PATTERN Generator, Model LT 1607, is only a little larger than a paperback book; and it meets the test-signal needs of most computer monitors, handling NTSC and Y/C monitors as well. Designed for both bench and field use, the instrument uses simple controls to call up raster formats for VGA, SVGA, XGA, MAC13, MAC 16, and MAC 19 computer monitors. The raster can be set to white, yellow, cyan, green, magenta, red, blue, and black.



CIRCLE 342 ON FREE INFORMATION CARD

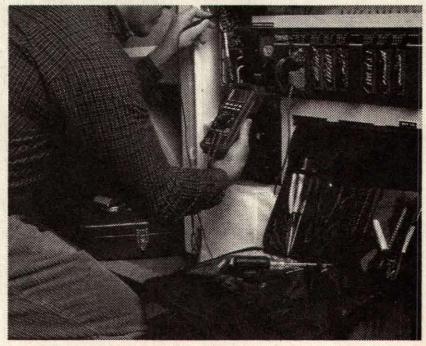
Among the test signals are color bars, circle/crosshatch, window, and computer characters. The unit outputs composite NTSC and Y/C feeds for adjustments of very large-screen displays and video walls. Selectable auto pattern sequencing is also available.

The suggested retail price for the model LT1607 is $995.

LEADER INSTRUMENTS CORP.
380 Oser Avenue
Hauppauge, NY 11788
Tel: 800-645-5104 or 516-231-6900
Fax: 516-231-5295
Web: www.leaderusa.com

Test Accessory Kits

THESE THREE NEW TEST ACCESsory kits feature different combinations of DMM test accessories for use with Amprobe's most popular meters (the AM-50, AM-71, AM90, and AM-1200 Series). Ideal for field use, these kits contain a wide variety of test accessories, ranging from: sets of test probes, both Maxigrabber and large alligator test clips, an extended tip adapter, flexible test leads, and spade lugs to modular electrical probes with durable stainless steel tips.



CIRCLE 343 ON FREE INFORMATION CARD

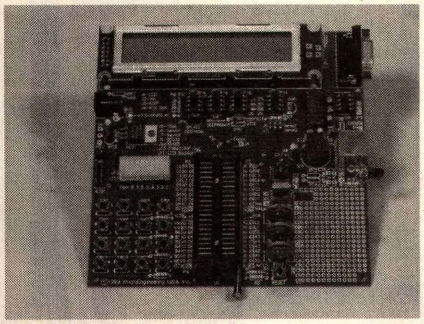
Kits are offered with either a large briefcase, shoulder pack, or tri-fold pouch for a variety of test environments, including plant maintenance, electrical, HVAC, automotive, and field repair. The test accessories are safely stored in multiple zippered and Velcro-enclosed compartments that also provide easy and convenient access. Constructed from durable material, the briefcases and shoulder packs are designed so that the test accessories can be stored with the meter.

The suggested retail prices range from $49 for the Basic Test Companion Kit and $89 for the shoulder pack to $189 for The Deluxe Test Companion Kit (IP9020), which is pictured here.

POMONA ELECTRONICS
1500 E. Ninth St.
Pomona, CA 91766
Tel: 909-623-3463
Fax: 800-444-6785
Web: www.pomonaelectronics.com

Experimenter's Board

THE PIC-X1 IS THE FIRST PRE-assembled experimenter's platform for the Microchip Technology PICmicro microcontrollers. It provides an assembled testbed containing most of the circuitry commonly used with PICmicros: 5-volt power supply, a crystal-controlled oscillator that includes jumpers, a reset circuit, as well as additional application circuits. The PIC-X1 can run programs written in assembler, C, and PicBasic or PicBasic Pro, and allows the resident PICmicro to be reprogrammed on the fly (with a flash device) using programmers that support this feature.



CIRCLE 344 ON FREE INFORMATION CARD

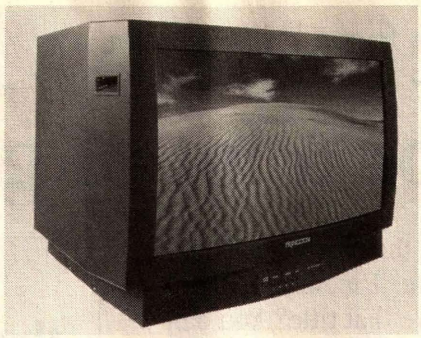
Application circuits include a switch matrix, potentiometers, LEDs, LCD module, serial EEPROMs, real-time clock, temperature sensors, servo connectors, RS232 and RS485 interfaces, IR interface, speaker, and a prototyping area. Designed to work with 40-pin PICmicros, it may be jumpered to work with smaller devices. The PIC-X1 is available in either bare PCB, kit, or assembled form; and it comes bundled with a parts list, schematic, and PicBasic Pro example programs.

The suggested retail price for the standard assembled version is $199.95. Educational pricing is lower.

MICROENGINEERING LABS, INC.
Box 7352
Colorado Springs, CO 80933
Tel: 719-520-5323
Fax: 719-520-1867
Web: www.melabs.com

HDTV Monitor

WHILE STILL COMPATIBLE WITH the NTSC signal, the AF3.0HD HDTV monitor is the first direct-view 16:9 aspect-ratio monitor to display all HDTV formats. The 30-inch viewable HDTV monitor includes six preset memories for DTV-resolution formats



CIRCLE 345 ON FREE INFORMATION CARD

and for VGA, SVGA, and XGA. It has a horizontal scanning range up to 50kHz, three color temperature settings, and custom memory settings for black level, contrast, geometry, and masking.

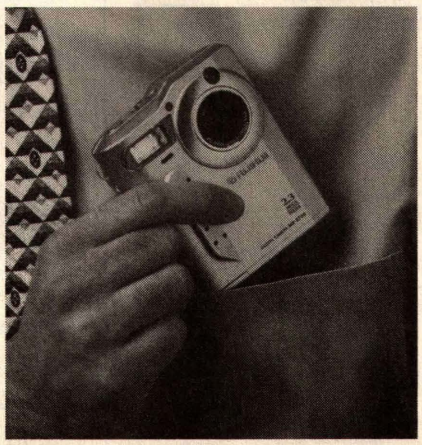
The AF3.0HD offers multiple inputs for digital, analog, and HDTV, plus color difference signals, VGA, S-video (Y/C), and composite inputs. Two remote controls, a built-in stereo audio amplifier, and two speakers are bundled with the monitor.

The AF3.0HD HDTV monitor has a suggested retail price of $4100.

PRINCETON GRAPHIC SYSTEMS
2801 South Yale Street
Santa Ana, CA 92704
Tel: 800-747-6249 or 714-751-8405
Fax: 714-751-5736
Web: www.prgr.com

Digital Mini-Camera

SMALL ENOUGH (3.1 BY 3.8 BY 1.3 inches) to fit into a shirt pocket, the MX-2700 Digital Camera is a double-megapixel model that lets photographers instantly see the images they want to shoot. The 2.3-million pixel MX-2700 features a 3mm equivalent lens with macro capability. Depending on the compression selected



CIRCLE 346 ON FREE INFORMATION CARD

(fine, normal, or basic), the camera can record 8, 17, and up to 35 images in 1800 × 1200 mode; or 47, 90, and up to 142 images in 640 × 480 mode.

The camera is equipped with both a precision, 2-inch polysilicon color LCD monitor with 130,00 pixels and an optical viewfinder, and it has video output and serial ports for computer connection. Automatic playback, a digital 2.5× telephoto mode, and the multi-frame playback that enables nine images to be viewed at once on the LCD are all features of the MX-2700.

The MX-2700 Digital Camera has a suggested retail price of $699.

FUJI PHOTO FILM U.S.A., INC.
555 Taxter Road
Elmsford, NY 10523
Tel: 800-800-FUJI
Web: www.fujifilm.com

DC Power Supply

A SINGLE-OUTPUT, VARIABLE 50-volt DC output (0–5A) power supply, the Model 5050S offers short-circuit and overload protection and provides fully isolated outputs. Ideal for lab, service, industrial, and educational uses, the Model 5050S has constant voltage/constant current modes, load/line regulation, and ripple specs.

CIRCLE 347 ON FREE INFORMATION CARD

Both fine and coarse voltage controls are available, along with indicators for constant voltage and current as well as for overload operation. The three-digit red LED display indicates both current and voltage output. The unit operates at 100/120/220/230V and has a power consumption of 420VA.

The 5050S variabel output power supply sells for $651.

HC PROTEK
154 Veterans Drive
Northvale, NJ 07647
Tel: 201-767-7242
Fax: 201-767-7343
Web: www.hcprotek.com

The Electronics Industry is looking for a lot of good people!

Here is your chance to get in on the ground floor as an Associate CET. Is your job title "Electronics Service Technician?" Would you like to have that title? You can prove you qualify for the title with a CET Associate Certificate. It can be your career door-opener and begin your rapid advancement!

A technician or student of electronics with less than a total of four years of basic experience may take the Associate Level Exam. The exam is the basic electronics portion of the full-credit CET exam. The 75-question, multiple-choice test covers basic electronics, math, DC and AC circuits, transistors and semiconductors, instruments, measurements and troubleshooting. A successful Associate CET will receive a wall certificate valid for four years and is eligible to join ISCET as an Associate Member. ISCET is the International Society of Certified Electronics Technicians.

The ISCET Computer-Aided Associate-Level Study Guide prepares you for the Associate CET Certificate by randomly selecting sample questions with appropriate diagrams, provides multiple-choice answers, grades the test and provides a summary of your strong and weak points.

Diskette requires IBM computer or compatible with VGA color monitor, 3.5-in. drive and a hard-disk drive.

CLAGGK INC. – CET Computer-Aided Study Guide Offer
PO Box 4099, Farmingdale, New York 11735

YES, I want to step up to a career in servicing. Here is my order for the CET Computer-Aided Study Guide on a 3.5 diskette. I am enclosing **$39.95** (price includes U.S. shipping and handling) in U.S. funds. Canadians and overseas add $6.00 per order for shipping.

Bill my ☐ VISA ☐ MasterCard Expire Date __/__/__
☐ USA Bank Check ☐ US or International Money Order

Card No. _____

Signature _____

Name (Please Print)_____

Address _____

City _____ State _____ Zip _____

New York residents add local sales taxes. Do not send cash. Checks drawn on US Bank and International Money Orders in US funds only. Credit card users may telephone or FAX orders. Telephone 516-293-3751 or FAX 516-293-3115. Price subject to change. Allow 6 to 8 weeks for delivery.

CB06

Proof Positive that you are a Certified Electronics Technician

A New Computer Software Program — ISCET Computer-Aided Associate-Level Study Guide

Prepare yourself for the 75-question CET Associate Examination. Model examinations provide the technician with a study program and introduction to the actual examinations. The model examinations are automatically graded in decimal numbers and bar graphs that can be outputted on your printer. The questions for each exam are selected randomly from a loaded data base—no two exams are exactly the same. When you answer a question, the correct answer is displayed and an explanation is given. From the printouts you will determine whether you need more practice and in which topic areas, or if you are ready to take the real test and continue to promote your electronics career today!

Listen to the Earth with this Seismic Detector

RON NEWTON

Want to find out what's happening underfoot? You can do just that with this inexpensive unit.

If you live in a seismically active area, you are no doubt aware of the "non-permanence" of the ground that you are standing on. Did you ever wonder if you have just felt a small earthquake, or was it only a passing truck? Perhaps you would like to explore the concept of volcanic eruption predictions.

The human body can detect a seismic event of about 2.5 or above on the Richter scale. A seismograph would be nice, but who can afford to have reams and reams of paper spewing out on the floor day after day? Besides, commercial seismographs are very expensive instruments and most are not portable.

To the rescue comes the Seismic Detector presented here, a portable and paperless device that is inexpensive and versatile. In addition to seismometers, the basic circuit can be used with other transducers such as LVDTs, differential pressure sensors, and accelerometers to name a few. Even with the use of expensive low-power components, the cost for parts is currently about $40; lower-cost standard components can be used if battery life is not a concern.

Design Features. Several features of the Seismic Detector contribute not only to its low cost but its usefulness as a geologist's instrument. Sensitivity is less than 2 on the Richter scale. At that level, it will be able to detect and record seismic events that we wouldn't notice. Up to eight separate one-minute events can be recorded and stored by the unit. Once an event has been detected and recorded, a light-emitting diode indicates that a seismic event has taken place and is stored in the system's memory.

The Seismic Detector can be connected to a PC for real-time monitoring of seismic events. That does not mean, however, that the Seismic Detector is restricted to any area that has a convenient wall outlet. Designed for portability and use in the field, it can run for about one year on a fresh set of batteries. Since it can collect data that might occur months apart, the date and time of each event is also stored by the unit.

Naturally, the computer interface can also be used for downloading any stored information for plotting and analysis.

Circuit Description. The schematic diagram of the Seismic Detector is shown in Fig. 1; follow it during the following discussion.

The heart of the system is SEN1, a vibration transducer. Manufactured by Geophone for use by the oil industry, it is a small can measuring 1 inch in diameter by 1.3 inches in height. It has a natural frequency of 10 Hz. If you open up a sensor, you'll find that it consists of little more

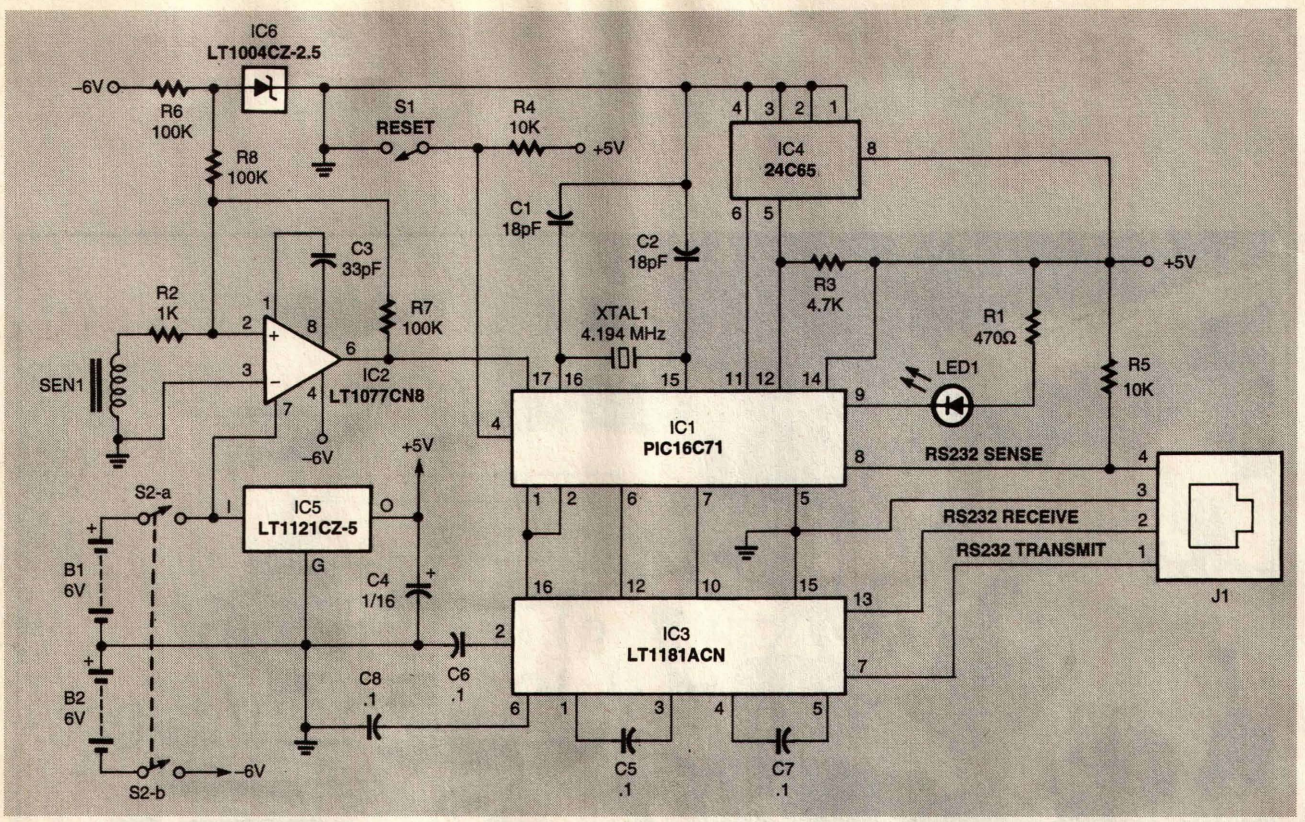
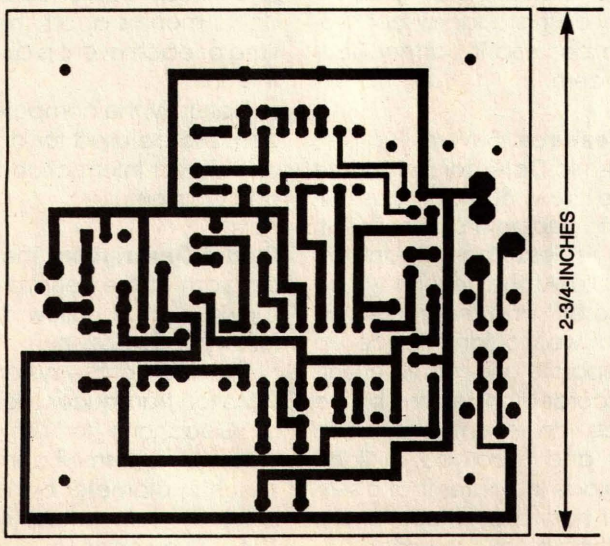


Fig. 1. Using low-power components to extend its battery life to a year of continuous operation, the Seismic Detector can store eight separate seismic events. Enough memory is provided for a minute's worth of samples per event—at 16 samples per second.

than a coil with a magnet suspended by a spring. When the sensor shakes, the magnet moves up and down within the coil. As everyone remembers from basic electricity, an electric current is generated when a conductor passes through a magnetic field. The sensor uses that effect to generate an AC voltage when it is moved. The intensity and shape of the AC signal is related directly to the amount of vibrational shock detected.

The output from SEN1 is very weak; IC2 amplifies it 100 times to boost the Seismic Detector's sensitivity. The amplified signal is applied to one of the inputs of IC1, a PIC16C71. That particular microcontroller features an on-board 8-bit analog-to-digital converter. There is a limitation on the input signal to the A/D converter—it cannot go negative, making measuring an AC waveform a bit difficult. The solution is to raise the voltage level of the signal so that it doesn't exceed the input specifications of the 16C71. Take another look at IC2; it is set up as a summing amplifier. A 2.5-volt offset is added to the sensor signal by using a precision reference diode, IC6. That voltage is at the halfway point on the A/D converters limits (128 on a 0–255 scale). Thus, a negative voltage will read



Here's the foil pattern for the Seismic Detector.

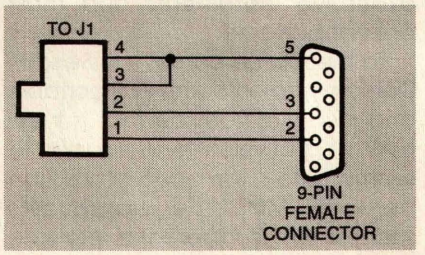
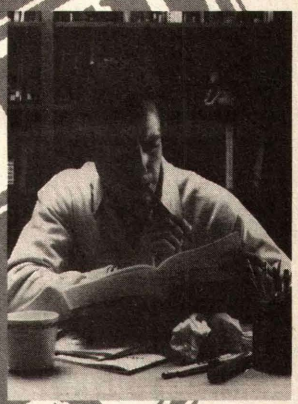


Fig. 2. This cable connects the Seismic Detector to a PC for downloading the recorded data as well as setting up the unit.

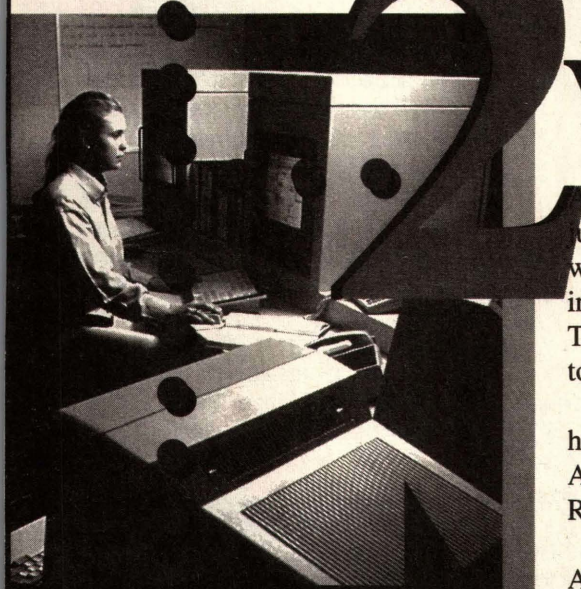
1 Study at Home

We live in a constantly changing world, where exciting new technological advancements are made everyday. At the Cleveland Institute of Electronics we make it simple to train, earn a degree and prosper in the workforce. Over 150,000 students in the United States and 70 foreign countries got their start in electronics through CIE. And they received their education at their own pace in the comfort and convenience of their homes. At CIE you'll receive a first class education by a faculty and staff devoted to your career advancement. All of CIE course and degree programs are taught through a patented, proven learning process. To discover all the benefits and programs/ degrees available from CIE send for your free course catalog today.



CIE's Associate Degree program contains 397 lab experiments.

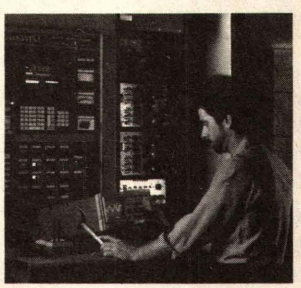
2 Work Where You Want



And once you complete your education at CIE, you can just about write your own ticket to where you want to work and in what specialized field... MIS, broadcasting, industrial, automotive, management... The opportunities seem limitless in today's high-tech world.

The Cleveland Institute of Electronics has been approved for use of Veterans Affairs Benefits and DANTES Tuition Reimbursement.

Tuition assistance from the Veterans Administration or the DANTES Program is available to veterans and service members in the Armed Forces.



Employees are seeking & hiring qualified applicants.

FREE CATALOG

CIE

1776 E. 17th Street
Cleveland, Ohio 44114-3679

Visit Our Web-Site
www.cie-wc.edu

☐ **YES!** I am interested.
Please send me a catalog.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone Number: _____

A school of thousands. A class of one. Since 1934. **AE149**

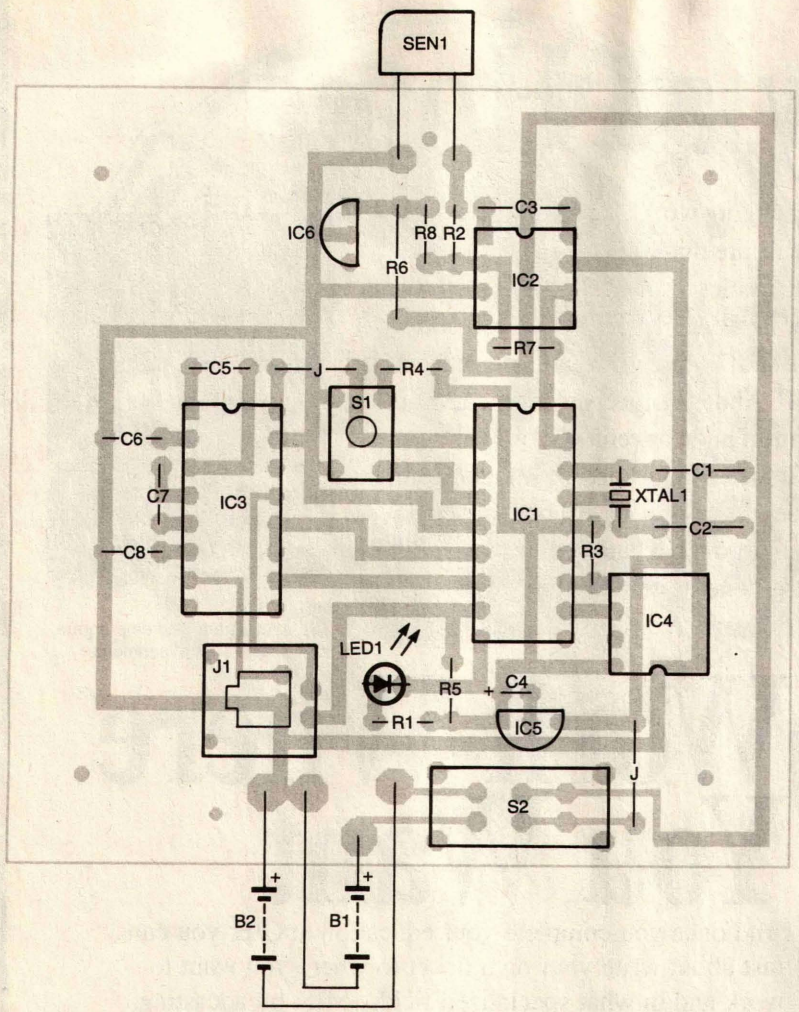


Fig. 3. The Seismic Detector is a simple circuit that fits on a small single-sided board. Only two jumpers are needed.

between 0 and 127; positive voltages will be between 129 and 255.

The frequency of XTAL1 was chosen so that together with the software that is programmed into IC1, precise timing lengths can be generated. For example, IC1 samples its analog/digital converter 16 times per second. If the reading is less than 123 or over 133, the software turns on LED1, which will flash every 15 seconds. One minute's worth of readings are stored in IC4, a serial memory chip. After a total of eight events, the system is set to "go to sleep" without taking any more readings no matter what happens. Due to the nature of how IC4 stores information, no data will be lost if power is lost. However, the unit will not take any more readings even if power is restored.

A bi-polar power supply is needed because of IC2. The positive side is supplied by four D-size batteries and is regulated to 5 volts by IC5, a low-power voltage regulator. A set of four AA cells provides the negative voltage for IC2.

Communications to a PC is handled by IC3, an RS232 interface chip. To conserve power, IC1 only activates IC3 when an adapter cable is plugged into J1. That adapter cable, shown in Fig. 2, shorts pins 3 and 4 of J1 together; IC1 watches for that condition. The Seismic Detector uses a 9600-baud rate to keep it compatible with the oldest of PCs.

Construction. The Seismic Detector's circuit is simple enough to build on a piece of perfboard using standard construction techniques. However, using a PC board makes for a neater appearance and eliminates most wiring errors.

If you choose to use a PC board, a foil pattern for a single-sided board has been included here. Alternatively, an etched and drilled board is available from the source given in the Parts List.

Before beginning assembly, note that IC1 must be programmed with the software that runs the Seismic Detector. The software for the Seismic Detector can be downloaded from the Gernsback FTP site (ftp.gernsback.com/pub/EN/seismic.zip). If you do not have access to a PIC programmer, a pre-programmed chip can be purchased from the source given in the Parts List, but download the software anyway. That package includes the PC software for reading back the information that the Seismic Detector has collected.

Start construction by placing the D-cell battery holder upside down with the wires to the left. Mount the AA-cell battery on the right side of the D-cell holder using double-sided tape or other suitable adhesive; the wires for both battery holders should face the same way.

Place the PC board on the left side of the D-cell battery holder. Mark the four locations where screws will hold the PC board to the holder. Drill those holes in the holder and set it aside.

If you are using a PC board that has been purchased from the source given in the Parts List or have etched one from the foil pat-

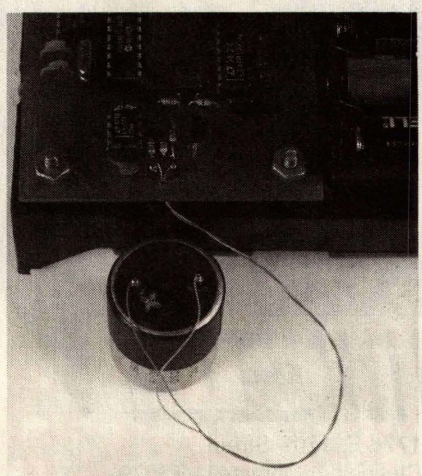


Fig. 4. The Seismic Detector relies on a vibration sensor that is used by the oil industry for exploration.

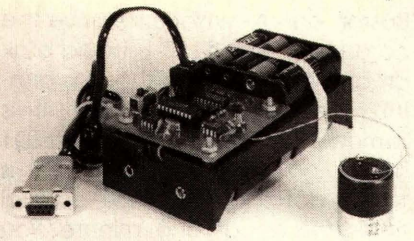


Fig. 5. The completed Seismic Detector is a compact, self-contained unit.

tern, use the parts-placement diagram shown in Fig. 3 to locate the various components. Note that there are two jumpers; they can be made from scrap pieces of component lead. In general, start with the smallest components and work your way up to the larger devices. Before soldering any polarized components, be sure to double-check their orientation. Burned semiconductors let you know that they have been installed backwards by releasing a puff of smoke and a unique odor that is unlike any other smell on Earth. Electrolytic capacitors, when installed the wrong way, have a way of failing that is—in a single word—"thrilling!"

A pair of square wire-wrap posts should be installed where SEN1 will be connected to the board. The integrated circuits can be soldered directly to the board; sockets can be used, but they might cause reliability problems after the Seismic Detector has been out in the field for several months exposed to extremes of temperature and humidity. Note the orientation of IC4; it is the reverse of the other chips.

You might want to consider a socket for IC1, especially if you are using the re-programmable version and might replace the program with one of your own design. Again, reliability and upgradability are the two features that you must choose between when it comes to the use of IC sockets.

When the board is done, look over your work carefully for poor soldering or missing, backwards, or misplaced components.

Note that there is a large strain-relief hole next to J1. Run the battery wires through that hole and solder them to the appropriate pads. The red wire from the AA batteries goes to ground and its black wire to the negative-voltage input. On the D-cell wires, the red goes to the positive-voltage input and the black to ground.

The transducer is connected to the board in a similar way; a strain-relief hole is next to the pads for the transducer wires. That hole is much smaller—use two different colors of wire-wrap wire. Twist the leads together and keep their length less than 12 inches to prevent any electromagnetic interference (EMI). The wiring method used in the author's prototype is shown in Fig. 4.

Mount the board to the back of the battery holder using standoffs, screws, and nuts. That completes assembly of the Seismic Detector itself.

Cut one end off of a modular 4-conductor telephone handset cord. Strip and tin the wires on the cut end. Following the schematic diagram shown in Fig. 3, connect the wires to a 9-pin connector. Use an ohmmeter or continuity tester if you are unsure as to which wire goes to which connector pin. The transmit line goes to pin 2 and the receive line to pin 3. Twist the ground and RS232 sensor wires together and solder them to pin 5.

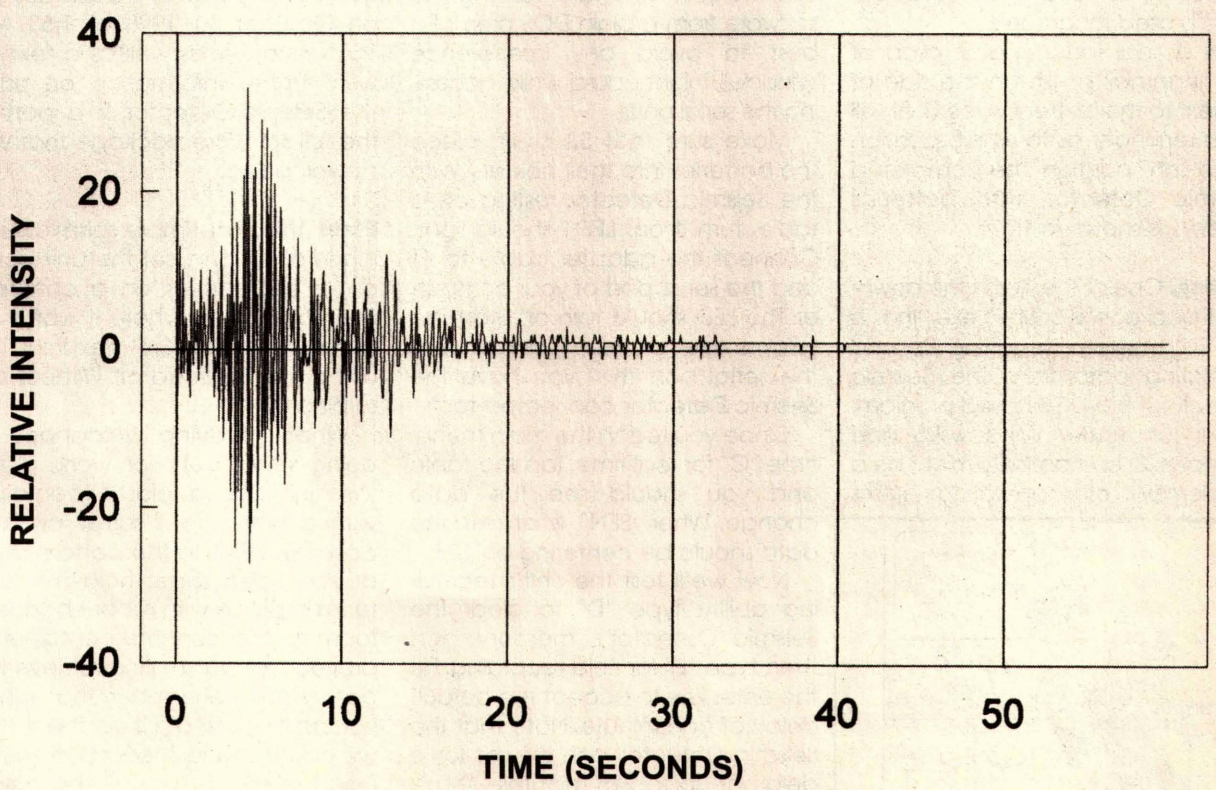


Fig. 6. An example of recorded data from the Seismic Detector is this plot of an earthquake that occurred in Carson City, NV on October 30, 1998.

PARTS LIST FOR THE SEISMIC DETECTOR

SEMICONDUCTORS

IC1—PIC16C71 microcontroller, integrated circuit
IC2—LT1077CN8 op-amp, integrated circuit
IC3—LT1181ACN RS-232 driver, integrated circuit
IC4—24C65 serial EEPROM, integrated circuit
IC5—LT1121CZ-5 low-power 5-volt regulator, integrated circuit
IC6—LT1004CZ-2.5 micropower 2.5-volt reference, integrated circuit
LED1—Light-emitting diode, red

RESISTORS

(All resistors are ⅛-watt, 5% units.)
R1—470-ohm
R2—1000-ohm
R3—4700-ohm
R4, R5—10,000-ohm
R6–R8—100,000-ohm

CAPACITORS

C1, C2—18-pF, ceramic-disc
C3—33-pF, ceramic-disc
C4—1-µF, 16-WVDC, electrolytic
C5–C8—0.1-µF, polyester

ADDITIONAL PARTS AND MATERIALS

B1, B2—6-volt battery
J1—modular telephone connector, PC-mount
SEN1—Seismic vibration transducer (see text)
XTAL1—4.194-MHz crystal
9- or 25-pin connector, four D-cell battery holder, four AA-cell battery holder, wire hardware, etc.

Note: The following items are available from Tahoe Chemical R&D; Tel: 702-885-8842; E-mail: sjnewt@aol.com: Pre-programmed IC1, $10; etched and drilled PC board, $15. Please add $5 for shipping and handling within US and Canada. NV residents must add appropriate sales tax.

SEN1 is available from: All Electronics, PO Box 567, Van Nuys, CA 91408-0567; Tel: 800-827-5432; item GP-1; and from Geo Space Corporation, 7334 N. Gessner, Houston, TX 77040; Tel: 713-939-7093; Web: www.geospacecorp.com; item GS-20DM.

If you need to use a 25-pin connector, pins 2 and 3 are reversed; pin 7 is used for ground.

As a final touch, put a drop of red fingernail polish on the side of S2 next to the battery wires. That will be a reminder as to which position is the "on" position. The completed Seismic Detector, with batteries loaded, is shown in Fig. 5.

Testing. One of the files in the download package is seismic.exe; that is the PC program for setting up and collecting data from the Seismic Detector. It is a DOS-based program; it will run under Windows95 and Windows98; compatibility might be a problem with other operating systems such as WindowsNT, Windows2000, and OS/2. At any rate, running the software from a plain DOS prompt is best to avoid any interference Windows might cause while accessing the serial ports.

Make sure that S2 is off; place the batteries into their holders. With the Seismic Detector resting on a table, turn it on; LED1 should light. Connect the adapter cable to J1 and the serial port of your computer. The LED should turn off. Start the seismic.exe program and select the serial port that you have the Seismic Detector connected to.

Once you reach the main menu, type "C" for real time. Tap the table and you should see the data change. When SEN1 is at rest, the data should be centering on 128.

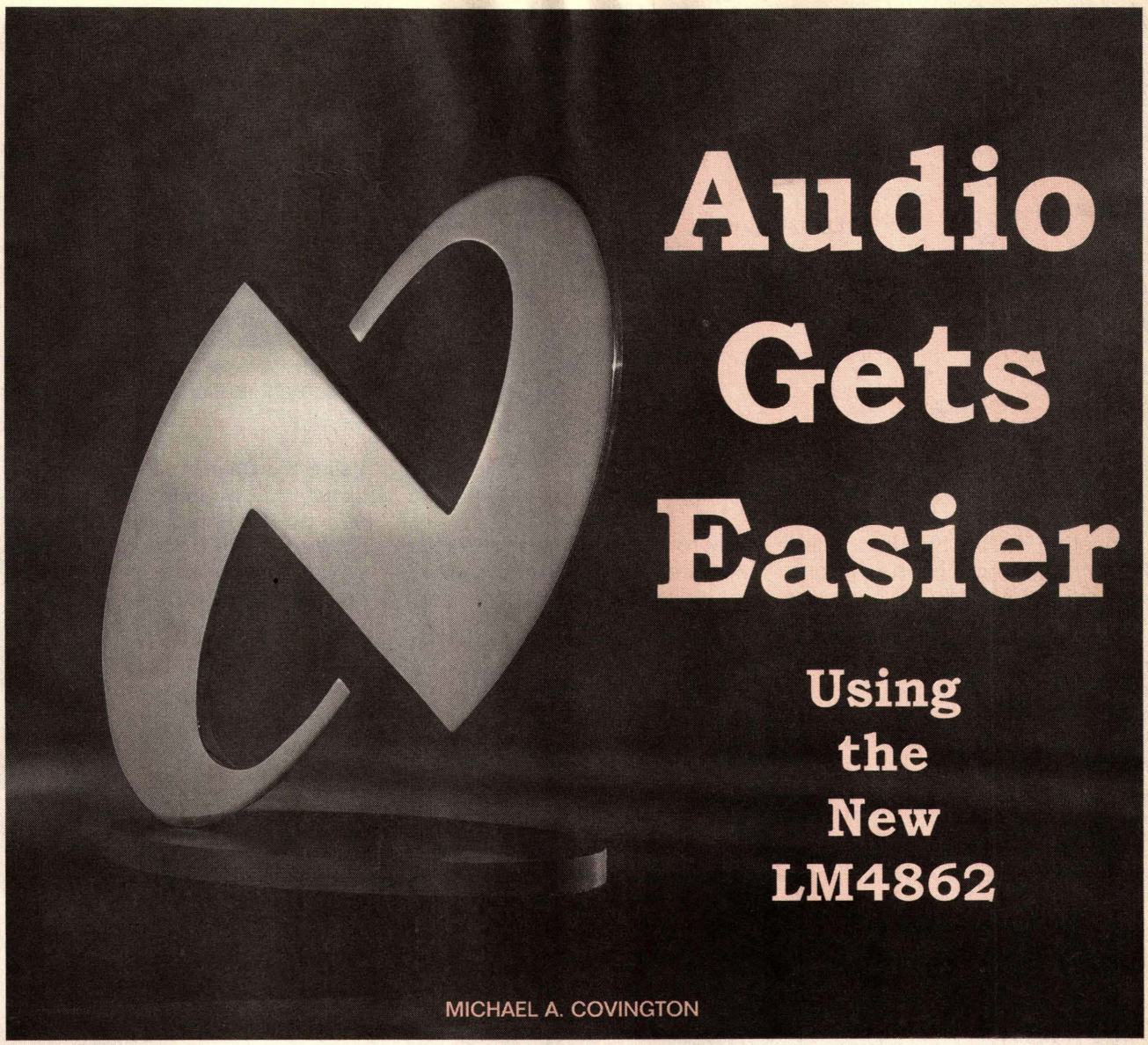
Now we'll test the unit's recording ability. Type "D" to clear the Seismic Detector's memory, and then type "E" for field recording. Hit the enter key to accept the default delay of one minute. Note that the Seismic Detector can be set for a delay of up to 255 minutes—that's four hours and 15 minutes, the approximate driving time between Boston and New York! Remove the cord from J1 and LED1 should blink on and off indicating that it is arming. Once LED1 goes out, it is armed. Tap the table and LED1 should go on indicating that it is taking data. Tap the table several times for about one minute. You can turn S1 off; the unit will retain its data.

Downloading. Plug the adapter cable into J1 and turn the unit on. At the main menu of the PC program, type "B" to choose the store-to-disk option, then type "A". Collection will automatically stop when all of the available data is downloaded. Once you are satisfied that you have stored the data you want, you can erase the memory as detailed above.

The data files can be read into any spreadsheet. Both Lotus 123 and Excel work well. The first large number is the date and its decimal is the time that the seismic event took place. The following data is seismic data. Use the spreadsheet's graphing function to display the data. An example of graphing a seismic event is shown in Fig. 6. That event took place in Carson City, NV on October 30, 1998 at 1:53 AM. That data file, as well as a text file with further information on using the Seismic Detector, is a part of the full software package that you downloaded.

Field Use. For simple seismic sensing in a building, set the unit down on its D batteries on a concrete floor in an area where it won't be disturbed. Place SEN1 next to it. The unit can be turned off without disturbing SEN1.

When studying volcanoes or doing other outdoor work, place the unit into a plastic container with a waterproof screw or snap cover. Fix SEN1 to the bottom using double-sided tape; hold the batteries in place with rubber bands or foam rubber. Bury the container to prevent vandalism and retrieve the data later. Remember that when you go back to dig it up, the shovel will cause the last recorded event! Don't forget to turn off the power when transporting the Seismic Detector. Ω



Audio Gets Easier

Using the New LM4862

MICHAEL A. COVINGTON

This new "Boomer" audio amp from National Semiconductor is easier to use, offers better performance, and needs fewer bulky external components than anything previously available.

Any electronic device that makes sound in a speaker—at least if the sound is more than digital beeps—needs an audio amplifier. Until now, the most popular IC for driving small speakers has been the LM386, introduced in 1975 by National Semiconductor. Figure 1 shows a typical circuit. Compared to the discrete-component circuits that preceded it, the LM386 was a godsend; it could deliver 0.2 watt into an 8-ohm speaker from a 9-volt supply without an output transformer.

But the LM386 wasn't perfect. As Fig. 1 shows, it requires large electrolytic capacitors, which add bulk and cost to the circuit and can distort the sound as they age. Further, the input impedance of the LM386 is very high, making it prone to oscillation if the inputs aren't carefully separated from the outputs. Its voltage gain of 20 (or 200 with one capacitor added) is a bit too high for line-level input (1V RMS) and contributes to the oscillation problem.

Twenty years went by, and National Semiconductor has recently introduced a new line of easy-to-use "Boomer" audio amplifiers. The handiest of these is the LM4862, which is available in both surface-mount and DIP packages with the same pinout (LM4862M and LM4862N respectively). It can deliver 0.675 watt into an 8-ohm speaker at 1% total harmonic distortion. (At slightly lower power levels, distortion is appreciably less.) What's more, it has automatic thermal shutdown to protect it from damage if overloaded, and it operates from a single 5-volt supply. The input impedance is relatively low and user settable, so the risk of oscillation is much lower.

Inside the Chip. Figure 2 shows what's inside the device. The LM4862 drives the speaker differentially, applying opposite waveforms to the two terminals—a configura-

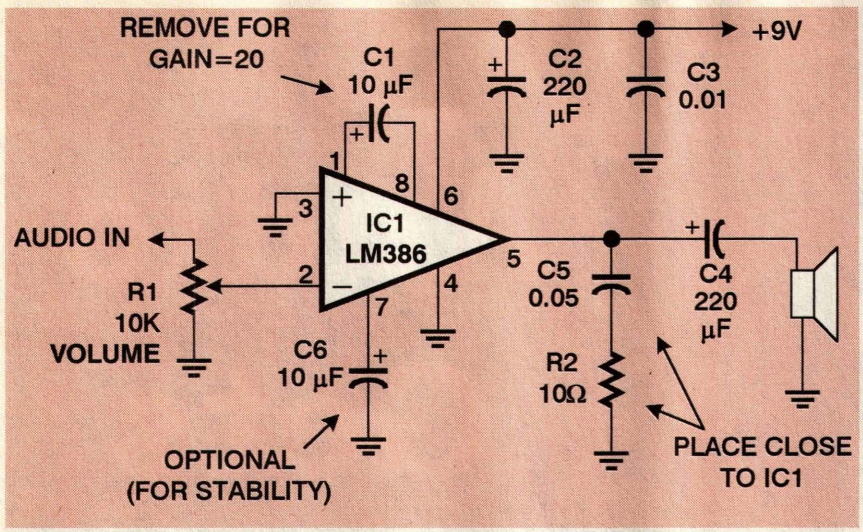


Fig. 1. The classic LM386 audio amplifier needs six capacitors, three of them electrolytic.

tion often called BTL (bridge-tied load). Either side of the speaker can go to +5V, while the other side goes to 0V. Thus, the amplifier can produce 10 volts of swing from a 5-volt supply. That's enough for room-filling volume with a 4-inch full-range speaker.

The supply voltage can range from 2.7 to 5.5 volts; naturally, the amplifier can deliver more power if the supply voltage is near the high end of the range. You can power the LM4862 from two or three 1.5-volt cells or a regulated 5-volt supply. (Do not use a 6-volt battery; it exceeds the maximum rating.) Total current consumption ranges from 5 mA when quiet to about 250 mA at maximum volume. Power-supply ripple rejection is excellent, better than 50 dB when C2 = 1 µF.

Using the Chip. A typical amplifier circuit is shown in Fig. 3. It's simple and does not require electrolytic capacitors; that keeps the cost down and ensures high-fidelity audio. Actually, C2, the bias bypass

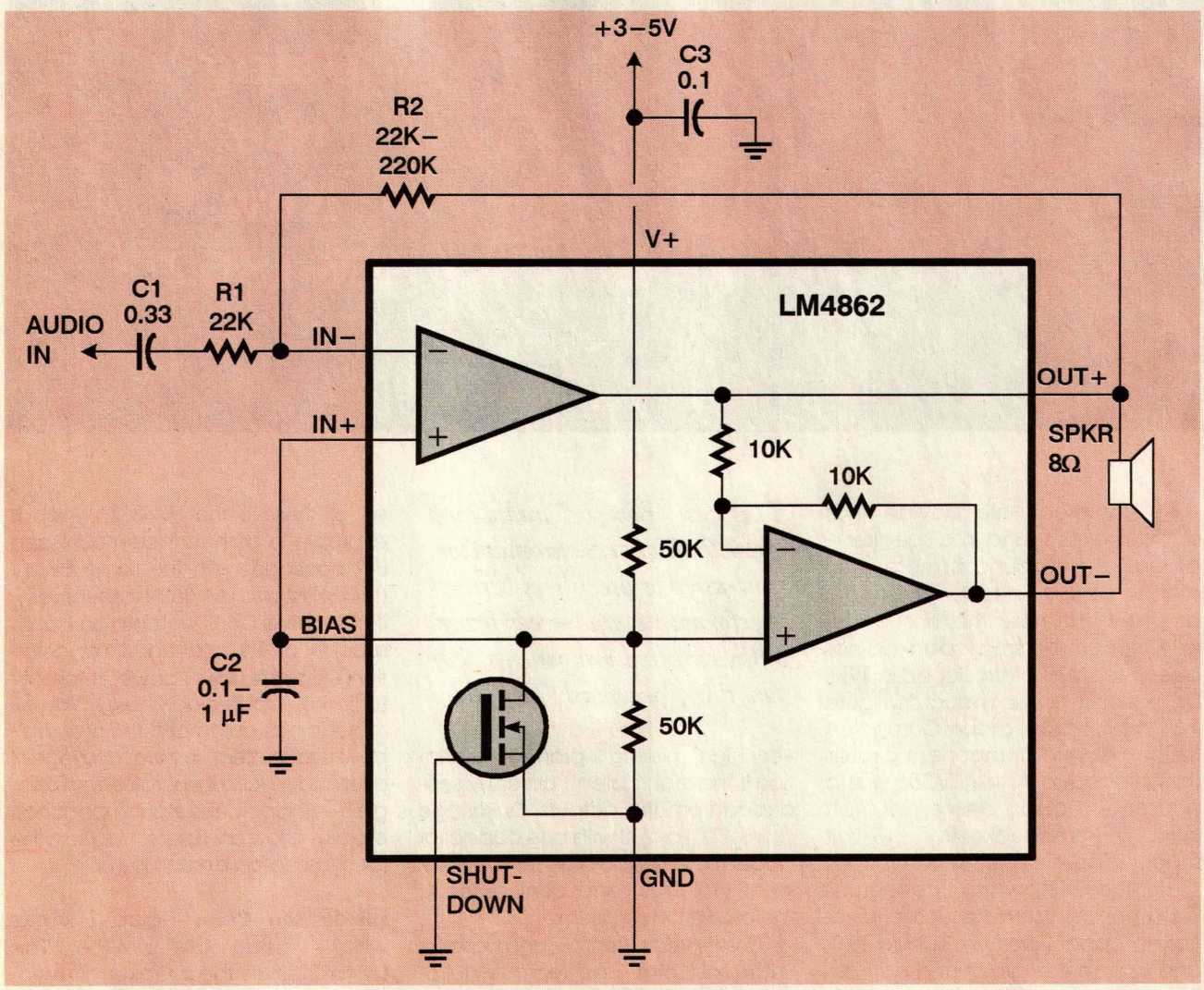


Fig. 2. The new LM4862 needs fewer external components and is less prone to oscillation than the LM386.

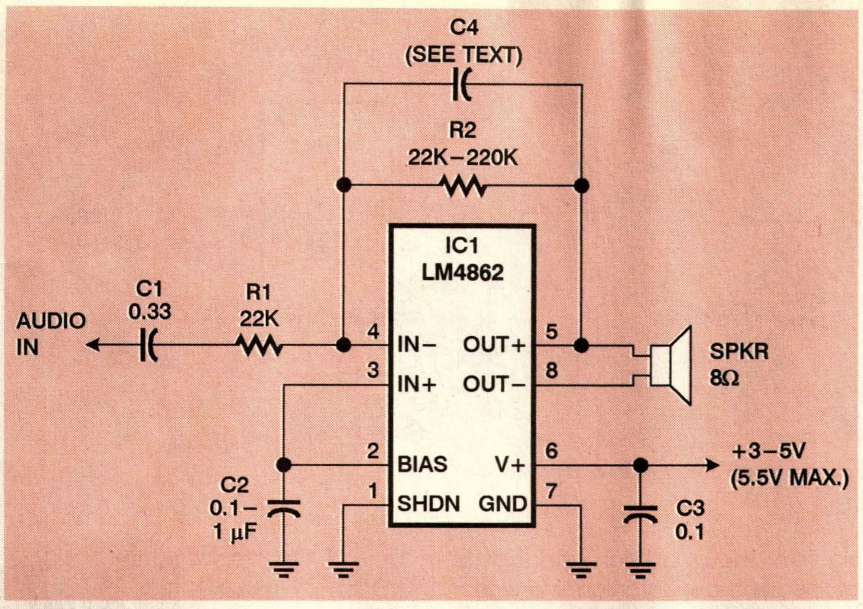


Fig. 3. A typical circuit using the LM4862. Place C3 as close to the IC as possible.

capacitor, can be a tantalum electrolytic; the audio signal doesn't pass through it. Also, a 100-µF electrolytic in parallel with C3 is a good idea when using batteries or a poorly regulated power supply.

The voltage gain is equal to 2(R2/R1) and should not exceed

	HIGH FIDELITY (20–20,000 Hz)	POWER SAVING (150–20,000 Hz)
LOW GAIN (A_V = 2)	R1 = 22K R2 = 22K C1 = 0.33 C2 = 1.0 µF C4 OMITTED	R1 = 22K R2 = 22K C1 = 0.05 C2 = 0.1 µF C4 OMITTED
HIGH GAIN (A_V = 20)	R1 = 22K R2 = 220K C1 = 0.33 C2 = 1.0 µF C4 = 22 pF	R1 = 22K R2 = 220K C1 = 0.05 C2 = 1.0 µF C4 = 22 pF

Fig. 4. Here are some component values for variations of the circuit in Fig. 3.

20; sound quality is best when R2 = R1 and the gain is 2. (That's exactly what you need to drive a speaker from 1-volt line-level or headphone-level audio.) When the gain is higher than about 5, R2 should be bypassed by a small capacitor (C4) to prevent oscillation. A 5-pF capacitor will do the job, but a 22-pF capacitor will probably be easier to find; do not use values larger than 32 pF. If the input signal is coming from a low-impedance source, you can use smaller resistors, such as R1 = 4.7K and R2 = 4.7K to 47K.

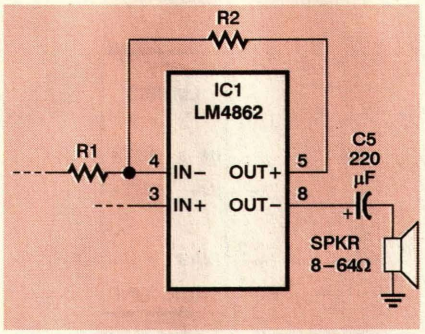


Fig. 5. How to drive a grounded circuit. The balance of the circuit is shown in Fig. 3.

Figure 4 gives component values for some typical amplifiers. Note in particular that you can save battery power, as well as component cost, by cutting the bass response when driving a small speaker that wouldn't reproduce low frequencies anyhow.

The speaker impedance must be at least 8 ohms. You can use a 16-, 32-, or 64-ohm speaker, but you'll get considerably less power out. If you must ground one side of the speaker, drive the other side through a capacitor as shown in Fig. 5; you'll get only a quarter as much power as if the speaker were driven differentially.

The shutdown (SHDN) pin disables the amplifier, bringing both outputs low and cutting power consumption to less than 1 micro-ampere (yes, microampere), when connected to +5V. The shutdown pin is grounded in normal use. You can use it to implement a "mute" button without putting a switch in the signal path, or even wire it to a headphone jack to silence the speaker when headphones are plugged in.

The bias pin is the output of a voltage divider built into the chip. Its purpose is to hold the positive inputs of both op-amps at half the supply voltage so that they can operate with a single supply. You can also use the bias pin to bias one or two additional op-amps as shown in Fig. 6.

The bias pin should be bypassed to ground by a capacitor between 0.1 and 1.0 µF. Larger values improve ripple rejection and suppress the "thump" when the amplifier is turned on.

Some Applications. The LM4862 teams up well with other low-voltage ICs. For example, Fig. 7 shows an experimental AM radio based on the Plessey (formerly Ferranti) ZN414 TRF receiver chip. On the breadboard, this circuit gave high-fidelity

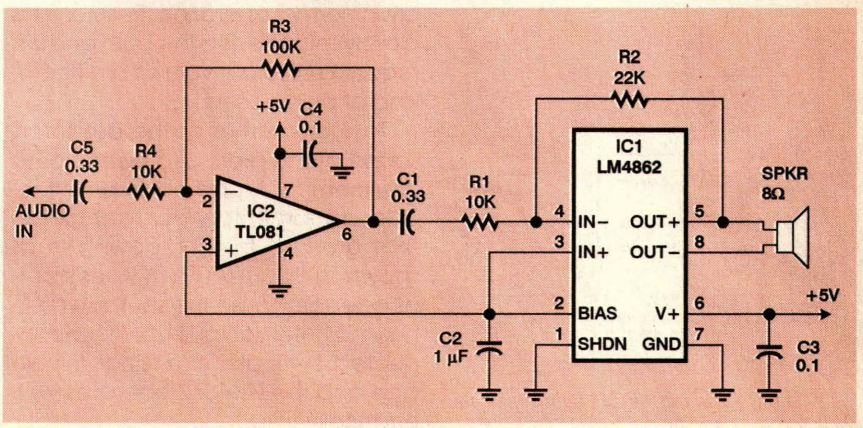


Fig. 6. You can use the bias pin, pin 2, to bias one or two external op-amps as shown here.

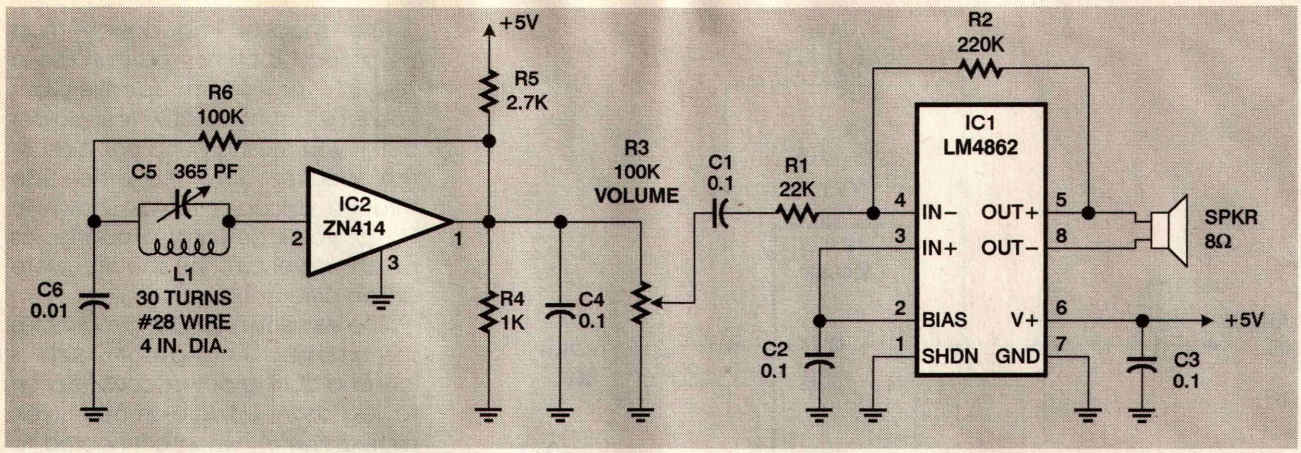


Fig. 7. When the LM4862 is combined with the Plessey (Ferranti) ZN414 receiver chip, the result is a simple, high-quality AM receiver.

reception of local AM stations.

Like other amplifiers, the LM4862 makes a fine oscillator. Figure 8 shows a classic op-amp square-wave oscillator that can serve as a loud siren—at least twice as loud as any conventional 5-volt circuit.

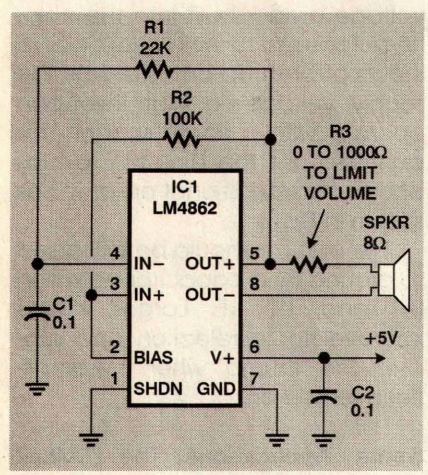


Fig. 8. This squarewave oscillator produces a loud 1-kHz tone in the speaker.

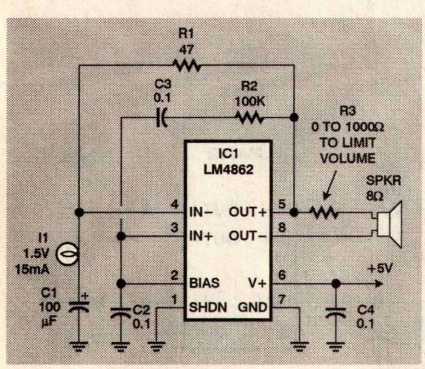


Fig. 9. A tiny "grain-of-wheat" light bulb is the feedback regulator in this circuit for a Wien-bridge oscillator.

Figure 9 shows a Wien bridge that produces a low-distortion sine wave.

In the last circuit, a 1.5-volt, 15-mA light bulb (RadioShack 272-1139) serves as the regulating element in the feedback loop. As current increases, the bulb heats up and its resistance increases, cutting feedback and stabilizing the oscillator. The bulb does not actually glow visibly in normal operation. Resistor R1 is closely matched to the bulb and will require a different value if a different kind of bulb is used.

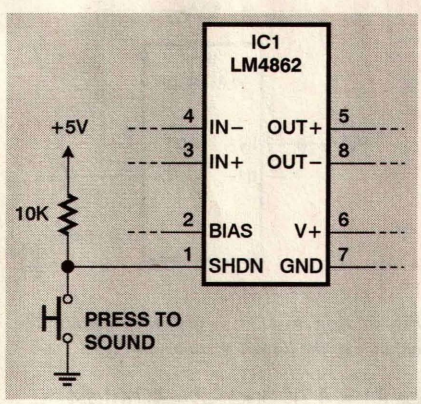
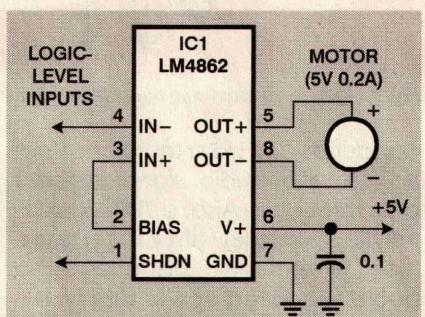


Fig. 10. The oscillators in Figs. 8 and 9 can be pushbutton controlled as shown here.

To make either of the oscillators sound at the press of a button or to use them for Morse code practice, add a momentary-contact switch that grounds the shutdown pin as shown in Fig. 10. The 10K resistor is needed because the shutdown pin has no internal pull-up; if unconnected, it "floats" to a random voltage and the LM4862 operates very erratically.

Finally, a speaker isn't the only thing the LM4862 can drive differentially. It also makes a fine full-bridge bi-directional driver for small motors. Figure 11 shows a circuit that was breadboard-tested with a 6-volt tape-recorder motor (running on 5 volts, of course). In this circuit, the inputs of the LM4862 are compatible with CMOS logic outputs, making computer control easy to implement.



INPUTS		MOTOR ACTION
SHDN	IN–	
+5V	ANY	STOP
0V	0V	RUN FORWARD
0V	+5V	RUN BACKWARD

Fig. 11. Using the LM4862 as a bi-directional motor controller.

Availability. One potential problem with the chip for hobbyists is that it is not that widely available. National does provide free samples to engineers and sometimes others. For more information, see their Web site at www.national.com. It is also available from traditional full-line distributors such as Newark Electronics (www.newark.com). Ω

Test Equipment for Audio Technicians:

Precision Dummy Load

Spruce up your test bench with a dummy load for testing amplifiers without the need for speakers.

GARY McCLELLAN

If you work with consumer-audio, musical-instrument, or professional-sound equipment, you probably know that good test equipment makes your work easier and faster. The ability to do a repair job quickly and efficiently is especially important if you are being paid for your efforts. The ability to service more audio equipment faster translates into making more money.

Unfortunately, most of the really helpful audio test equipment is hard to find because only a few specialty stores offer it—if it is made at all Once such piece of gear is an eight-ohm, 320-watt dummy load. As you probably know, a dummy load is temporarily connected in place of speakers for testing an amplifier. A dummy load offers a safe, practical way to test for power output, distortion, and hum or noise output after the amplifier has been repaired. It can accommodate anything from a simple five-watt guitar amplifier to the 300-watt units used in professional sound systems.

Obviously, a dummy load is a useful test-bench accessory. The funny thing is that if you want one, you'll have to build it: for some reason, commercial dummy loads are not available as off-the-shelf products. Thankfully, the parts are readily available and the work is easy.

How It Works. The Dummy Load is a simple device, as you can see from the schematic diagram in Fig. 1. It uses a series/parallel combination of 16 power resistors to make up a value of 8 ohms. Using 20-watt units, the Dummy Load has the ability to dissipate 320 watts of power. To calculate the resulting value of a series/parallel resistor network, first add all of the series-resistor values together, and treat those results as large resistors in parallel. In the Dummy Load, the four strings of series resistors configuration takes advantage of low-cost, widely-available resistors. Consider the alternative of obtaining two 250-watt resistors and connecting them

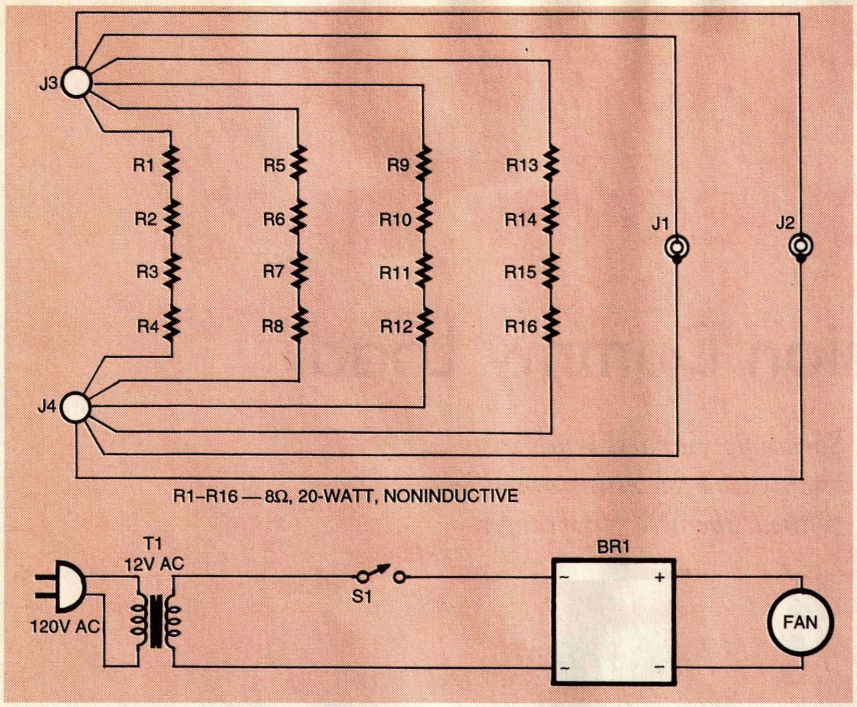


Fig. 1. The Dummy Load is simply a set of resistors that dissipate energy while testing an amplifier under load without having to hook up a speaker—a much noisier option! Using several resistors in a series/parallel arrangement lowers the cost of the unit as well it increases the accuracy; multiple resistors tend to cancel out tolerance differences between different resistors.

in series: a pair of Vishay/Dale 4-ohm 250-watt resistors currently cost over $108 from industrial distributors. Not only is that cost prohibitive, it is almost impossible to acquire the components if you are a hobbyist. The cost of the resistors in the Dummy Load is only about $24, and they can easily be found locally.

Note that the resistors specified are non-inductive units that are specifically designed for audio applications. The special construction of those devices insures that the load impedance doesn't rise with frequency, which would affect the power output of the amplifier. That consideration is especially important if you are going to do any testing at 20 kHz.

Other benefits of the series/parallel configuration include improved precision and reasonably fail-safe protection. Resistance errors tend to average out, resulting in a total value closer to 8 ohms when compared to a single resistor. For example, the author's prototype measured 8.06 ohms. In terms of fail-safe protection, consider what would happen if a single resistor burns out. If that happens, the load increases to 10.6 ohms but it doesn't go open circuit. That feature is essential when testing tube amplifiers where an open circuit at full-power output will destroy an expensive output transformer.

A pair of banana jacks, J3 and J4, is used to connect the Dummy Load to an amplifier. Additional monitoring jacks (J1 and J2) are provided for a distortion analyzer and oscilloscope. Note that the ground sides of those monitoring jacks are connected to J4; keep that in mind when you are connecting the Dummy Load to a piece of equipment.

At high power levels, the resistors get quite hot. A built-in fan keeps the resistors cool during any periods of high-power testing. A simple source of 12-volt power (T1) is rectified by BR1 and used to power a 12-volt DC "boxer"-type fan. Switch S1 turns the fan on and off.

Building the Dummy Load. The Dummy Load is easy to build. With a little bit of luck, you might have all of the necessary parts available in your "junk drawer." Here are some suggestions for "fine-tuning" the Dummy Load to better suit your needs and available parts.

If you don't need the 320-watt power-handling capability, you can use three rows of three resistors; the power rating will be 120 watts—fine for the majority of consumer stereo and musical-instrument amplifiers.

Any case can be used that's large enough to hold all of the parts and is made of metal. A metal cabinet is required for fire-safety reasons. An example of using a suitable cabinet comes from one technician who used the finned-heatsink cabinet from an old automotive stereo amplifier. The internal circuitry was removed and a new end panel made from scrap aluminum.

If you are using resistors from your junkbox or other surplus source, you might have to spend some time with a hand-held calculator until you find a series/parallel combination that yields 8 ohms. It's important to use power resistors marked "non-inductive." However, if you are not overly concerned with qualitative measurements as done by high-end testing labs, conventional resistors don't have enough inductance at the standard 1-kHz test frequency used in most service facilities to cause serious errors.

If you can't find the screw-mounted insulated posts that will hold the resistors in place, use terminal strips. Do not mount the resistors on a PC board; the board could burn and produce dangerous fumes. The fan is a common unit that can be removed from an old personal-computer power supply.

The author's prototype is shown in Fig. 2. As you can see from the photo, the resistors are arranged in

PARTS LIST FOR THE DUMMY LOAD

BR1—50-volt, 6-amp bridge rectifier
J1, J2—BNC jacks, panel-mount
J3, J4—Banana jacks or 5-way binding posts
R1–R16—8-ohm, 20-watt non-inductive resistors
S1—Single-pole, single-throw switch
T1—12-volt AC, 400-mA transformer
12-volt DC fan, aluminum case, rubber feet, wire fan guard, insulated tie points, rubber grommets, wire, hardware, etc.

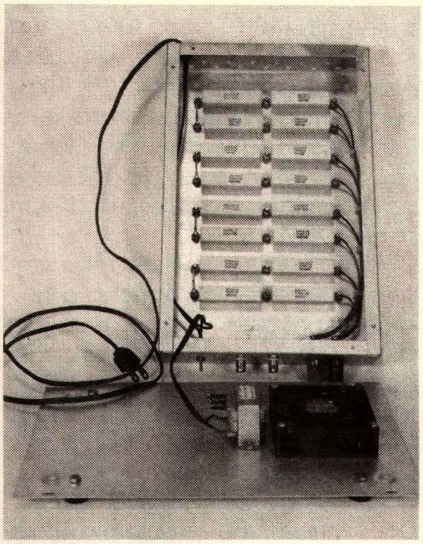


Fig. 2. The Dummy Load is built in a metal housing with a fan for forced-air cooling. Each resistance string is wired to the output jacks individually.

eight rows of two resistors per row. Space the rows at least 1 inch apart. Drill mounting holes for the insulated mounting posts that will hold the resistors in the top of the case—24 are needed. The jacks as well as S1 are mounted on the front. A suitable hole for the fan's power-supply cord is needed in the back of the unit. The back of the case will also need several ventilation holes. The fan and its power supply are mounted on the base plate near the front.

Once all of the holes are drilled or cut and deburred, clean the cabinet, paint it, and apply labeling as desired. The author's unit sports a "distressed" finish that was done with a wire brush chucked in an electric drill then cleaned and coated with a clear lacquer spray.

When the case's finish is dry, install the components. Make sure that none of the jacks are grounded to the cabinet. Mount the 24 insulated posts or terminal strips. The fan should be positioned so that the airflow will draw cold air through the bottom of the cabinet and push it through the resistors and out the back of the unit. Finally, mount BR1 and T1.

When installing the resistors, be sure that the body is suspended in space between the terminals. That insures good airflow around the resistors, reducing heat buildup. Note how every other row is connected to its neighbor, resulting is a set of four resistors in series.

Wire J1 and J2 to J3 and J4 with short pieces of hookup wire. When wiring the resistors to J3 and J4, use heavy-gauge wire; 16-gauge should be considered a safe minimum. As suggested in Fig. 1, do not "bus" the resistor branches together and use a single wire to connect to J3 and J4; that will cause measurement errors.

Pass the power-cord wire through the grommet and wire the cooling circuit (S1, T1, BR1, and the fan). Leave about eight inches of wire between S1 and T1 so that it is easier to work on the Dummy Load when it is opened up.

With construction complete, check your work for errors and correct any that are found. Mistakes to watch for include unsoldered connections, cold-solder joints, shorts between adjacent connections, and incorrectly installed parts. Close the case and the Dummy Load is ready for testing and use.

Testing the Dummy Load. Before using the Dummy Load, it is wise to make a few tests. Plug the unit in and verify that the fan runs when S1 is closed. Measure the resistance across J1, J2, and between J3 and J4. The reading must be 8 ohms. Measure the resistance between the cabinet and either J1 or J2; those jacks must be completely isolated. If those checks pass, the Dummy Load is ready for use. If not, recheck the wiring and repair any faults.

You might want to make some patch cables for easy connection between the Dummy Load and the amplifier under test. A four-foot length of 12-gauge two-conductor power cable makes for a rugged test lead. If you work with musical-instrument amplifiers, attach a 1/4-inch phone jack to one end and suitable connectors for mating with J3 and J4 on the other. You can make several types of patch cables for whatever type of equipment you'll be working with; for example, heavy-duty spade lugs for professional equipment or stripped and tinned wire ends for consumer audio equipment. It is a good idea to color code the two wires so that you can tell which lead should be connected to J4, and in turn to the measuring equipment's ground.

Basic Amplifier Testing

Although amplifier test methods are beyond the scope of this article, here is a simple continuous-power-measurement procedure to get you started:

1. Increase the audio oscillator level until a slight flattening of the waveform peaks appears. That point represents roughly 3% Total Harmonic Distortion (THD). Record the voltage across the load on the analyzer's AC voltmeter. Turn the oscillator level to zero immediately after you finish the measurement.

2. Calculate the power output using the formula $P=I \times 28$. Subtract 10% from that value. Record that value as the rated power output.

3. Adjust the oscillator level for the rated power output and measure the distortion. Record the distortion and voltage across the lead. Turn the oscillator level to zero.

4. If desired, you may measure hum and noise by disconnecting the audio oscillator, shorting the amplifier input, and noting the voltage reading on the analyzer's AC voltmeter. Then calculate the difference in dB using the formula:

dB(loss)=20 Log E rated power/E hum noise

Using the Dummy Load. The Dummy Load is easy to use once you understand some of the basics of testing amplifiers under load. Connect the amplifier output to J3 and J4 with appropriate patch cables. Be sure that the ground connection on the amplifier goes to J4. If you are testing an amplifier with a bridging output, you *must* isolate the distortion analyzer and oscilloscope from ground. Otherwise, one side of the amplifier will be shorted to ground through the instrument power cords, damaging the amplifier. Use ground-isolated or battery-operated instruments. Alternatively, you can temporarily install 3-wire adapter plugs on the instrument power cords to "float" their grounds.

Connect a distortion analyzer to either J1 or J2 and an oscilloscope

Electronics NOW REPRINT BOOKSTORE

☐ **229** Popular Electronics (1999 back issues) **$5.00**
Write in Issues desired _____

☐ **228** Popular Electronics (1998 back issues) **$5.00**
Write in Issues desired _____

☐ **227** Popular Electronics (1997 back issues) **$5.00**
Write in Issues desired _____

☐ **226** Popular Electronics (1996 back issues) **$5.00**
Write in Issues desired _____

☐ **225** Popular Electronics (1995 back issues) **$5.00**
Write in Issues desired _____

☐ **EH96** Experimenters Handbook (1996) . . . **$5.00**

☐ **EH95S** Experimenters Handbook Summer Edition (1995) **$5.00**

☐ **EH94S** Experimenters Handbook Summer Edition (1994) **$5.00**

☐ **EH94W** Experimenters Handbook Winter Edition (1994) **$5.00**

☐ **EH94** Experimenters Handbook (1994) . . . **$5.00**

☐ **EH93** Experimenters Handbook (1993) . . . **$5.00**

☐ **HH95S** Hobbyists Handbook Spring Edition (1995) **$5.00**

☐ **HH95F** Hobbyists Handbook Fall Edition (1995) **$5.00**

☐ **HH94S** Hobbyists Handbook Spring Edition (1994) **$5.00**

☐ **HH94F** Hobbyists Handbook Fall Edition (1994) **$5.00**

☐ **HH93** Hobbyists Handbook (1993) **$5.00**

☐ **HISTORY** Crystal Radio History, Fundamentals & Design **$10.95**

☐ **XTAL** Crystal Set Handbook **$10.95**

☐ **XTALPRO** Crystal Set Projects **$14.95**

☐ **XTALBLD** Crystal Set Building **$15.95**

☐ **POP96** POPtronix Hobbyist Handbook (1996) **$5.00**

☐ **POP97** POPtronix Exper Handbook (1997) **$5.00**

☐ **Radiocraft** 1993 Projects for Hobbyists . . . **$5.00**

☐ **219** Electronics Now (1999 back issues) . . **$5.00**
Write in Issues desired _____

☐ **218** Electronics Now (1998 back issues) . . **$5.00**
Write in Issues desired _____

☐ **217** Electronics Now (1997 back issues) . . **$5.00**
Write in Issues desired _____

☐ **216** Electronics Now (1996 back issues) . . **$5.00**
Write in Issues desired _____

☐ **215** Electronics Now (1995 back issues) . . **$5.00**
Write in Issues desired _____

REPRINTS **REPRINTS**

☐ **174** Electronics Cartoons (The Best of) . . . **$1.99**

☐ **173** From Not-Working to Networking Troubleshooting Local-Area Networks . **$2.99**

☐ **172** 33 Bench-Tested Circuits **$1.99**

☐ **171** 36 Time Tested Circuits **$1.99**

☐ **170** High-Voltage Project for Fun and Science Book 1 . . . . . **$2.99**

☐ **170A** High-Voltage Projects for Fun and Science Book 2 . . . . . **$2.99**

☐ **169** Think Tank (133 Circuits) **$1.99**

☐ **169A** Think Tank Vol. 2 . . . . . **$1.99**

☐ **168** Fact Cards (#34-66) **$1.99**

☐ **168C** Fact Cards (#67-99) **$1.99**

☐ **168D** Fact Cards (#100-132) **$1.99**

☐ **167** Designing With IC's **$2.99**

☐ **166** Collected Works of Mohammed Ullyses Fips (62 pages, April Fools Collection) . **$6.99**

☐ **165** How to Repair CD Disc Players **$2.99**

☐ **164** Modern Electrics (April 1908) **$1.99**

☐ **160** New Ideas - 42 Circuits **$1.99**

☐ **159** Low Frequency Receiving Techniques Building and Using VLF Antennas **$2.99**

☐ **158** Electro Importing Co. Catalog (Circa 1918) **$2.99**

☐ **157** All About Kits **$1.99**

☐ **156** How To Make PC Boards **$1.99**

☐ **154** How To Repair VCR's **$1.99**

To order any of the items indicated above, check off the ones you want. Complete the order form below, include your payment, check or money order (DO NOT SEND CASH), payable to and mail to Claggk Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735.

Please allow 4-6 weeks for delivery. No COD's!

To place a credit card by phone, Visa Mastercard or Discover only. You can also order and pay by e-mail. Contact Claggk@gernsback.com for details.

CALL: 516-293-3751.

To use your Visa, Mastercard or Discover, complete the following:

Bill my ☐ **Visa** ☐ **Mastercard** ☐ **Discover**

Card No. _____

Exp. Date _____

Signature _____

MAIL TO: Claggk Inc.
Reprint Bookstore, P.O. Box 4099, Farmingdale, NY 11735
SHIPPING CHARGES IN USA & CANADA

All payments must be in U.S. funds

Up to $5.00	$2.00	$30.01 to 40.00	$6.00
$5.01 to $10.00	$3.00	$40.01 to 50.00	$7.00
$10.01 to 20.00	$4.00	$50.01 and above	$8.50
$20.01 to 30.00	$5.00		

Overseas Orders must contact CLAGGK for shipping charges.

Total price of merchandise . . . . . $ _____
Shipping Charge (see chart) . . . . . $ _____
Subtotal . . . . . $ _____
Sales Tax (New York State Residents only) . . . . . $ _____

Name _____ Total Enclosed . . . . . $ _____

Address _____

City _____ State _____ Zip _____ CL01

to the other BNC jack. Turn on the fan and power up the amplifier. Adjust an audio oscillator for 1 kHz and turn the output level to zero. Connect it to the amplifier's input. You are now ready to measure power output, distortion, and hum or noise levels.

While the Dummy Load is a simple and rugged instrument, a few suggestions are in order to help you get a long life out of it and to avoid costly equipment mishaps. When testing solid-state amplifiers, check the output with a DC voltmeter before connecting the Dummy Load. If the reading is over 200 mV DC, correct the problem before going any further. When testing tube amplifiers, always connect the Dummy Load before turning on the power. If you don't, there is a possibility of damaging the amplifier's output transformer—a rather costly mistake! Be sure to use the 8-ohm tap on the amplifier for maximum power output.

If you use a digital multimeter as an AC voltmeter instead of a distortion analyzer, be aware that the accuracy on most units degrades above 500 Hz. That will be a problem if you try to perform frequency response testing on the amplifier. Check your DMM manual to be sure.

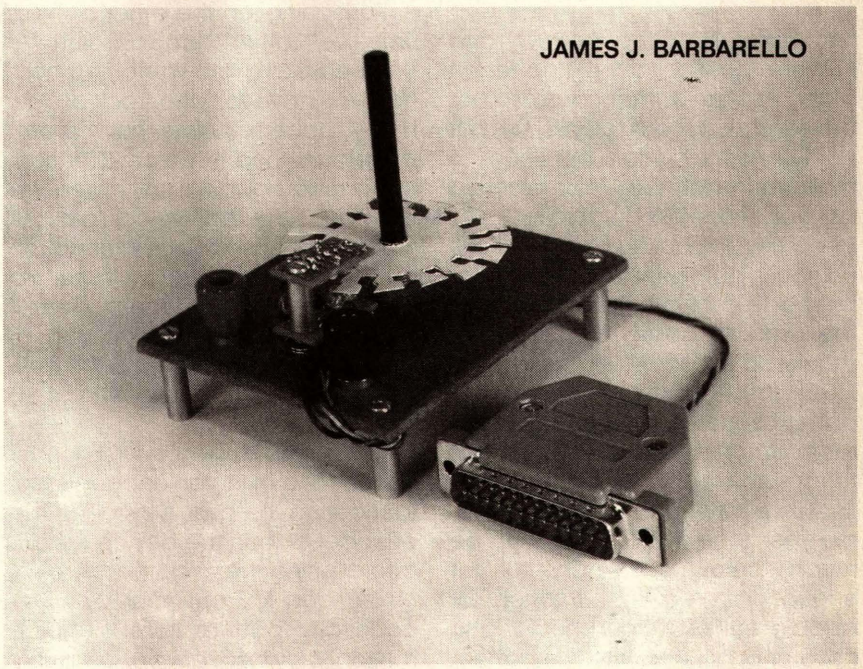
Finally, remember that the Dummy Load is intended for short-term testing. Do not run the unit at full power over 5 minutes at a time, or any time with the fan turned off. If you do, the resistors might overheat, change value, and burn up. Ω

POPTRONIX®
Online Edition
We're on the web ***FREE***
http://www.poptronix.com
WE'RE WITH YOU EVERY DAY
24 HOURS A DAY! DROP IN!
WE'D LOVE TO HAVE YOU VISIT!

An Infrared-Based Rotary Encoder

Measure the position of any rotary shaft.

JAMES J. BARBARELLO



There are times when you need to know the position of a rotary device like a potentiometer or a wind vane. You could do that by linking the device's shaft to a commercially-available encoder, but that approach has some drawbacks. The mechanics of connecting the encoder and shaft might be awkward or difficult; in some cases, it's impossible. Encoders are not the easiest components to find, and they are a bit pricey when you do.

Luckily, there's another approach that's mechanically simple and uses readily available, cheap parts. That approach uses an Infrared (IR) LED as a light source and an IR phototransistor to detect the IR light. The theory is simple: point the source at the detector. The IR energy from the source will cause the base-emitter junction of the detector to conduct. If the IR is blocked, the detector shuts off. Slipping a perforated piece of common paper (which, by the way, doesn't transmit IR energy) on the shaft that we want to monitor together with the encoder electronics creates a simple and low-cost rotary encoder. Any PC can read both the position and direction of a shaft. What's more, we're not restricted to rotary position sensing, as you'll see.

Theory of Operation. Figure 1 shows the schematic diagram for the IR Encoder. The circuit requires 5 volts DC, which is provided by IC1. That regulator can be eliminated if you have an available source of regulated 5-volt power. As shown, any unregulated 8–13-volt DC source, such as a 9-volt battery or a DC wall transformer, can be used. Capacitors C1 and C2 provide filtering.

Resistors R1 and R4 feed infrared sources D1 and D2 respectively. The current, set by the resistors, is about 11 mA. Their outputs physically shine on detectors Q1 and Q2. Pull-up resistors R2 and R3 have the same function as a standard inverting transistor stage.

The key to making such a simple circuit into an accurate position and direction encoder is the encoder disk's cutout pattern. Shown in Fig. 2, it creates four dis-

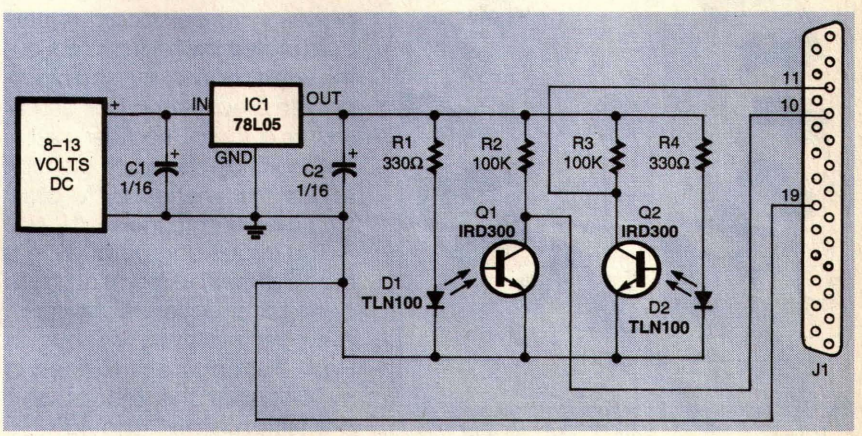


Fig. 1. The Infrared Encoder circuit is very simple. An infrared diode shines on a phototransistor. Anything opaque that blocks the infrared light turns the transistor off.

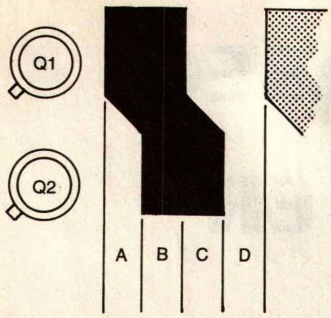


Fig. 2. The pattern for the encoder disc is divided into four "zones." The pattern is shaped so that only one sensor changes state at a time.

tinct zones. Note that both Q1 and Q2 are positioned next to each other. As the pattern passes over the sensors, zone A blocks Q1 but not Q2. As the pattern continues to move to the left, Q2 will be blocked as well (zone B). In zone C, Q1 becomes unblocked. Finally, zone D unblocks both sensors. The pattern is repeated at a similar spacing to the pattern shape; all four zones should be the same width.

Another important aspect of the pattern zones is that they are correctly sized to the diodes and phototransistors being used. The specified units have a 0.125-inch diameter. The zone size should not be much below 0.08-inch to let enough infrared light through for reliable sensing. You should also have enough length to the pattern in order to compensate for any misadjustment; double the sensor's diameter should be plenty.

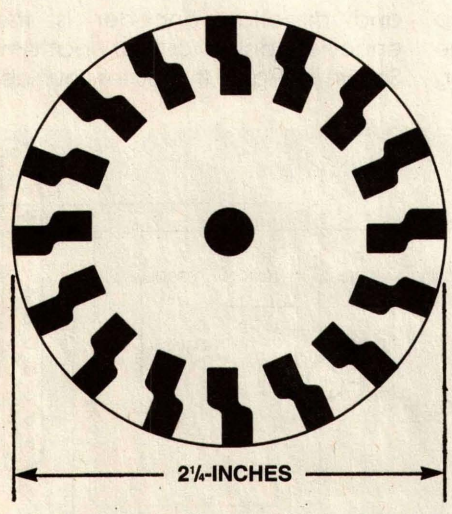


Fig. 3. Here is a sample pattern for the encoder disc. It is designed to fit onto a /-inch shaft. Any stiff paper or index card will work well, as long as the chosen material blocks infrared light.

The shape of the pattern is key to determining in which direction the pattern is moving. Let's say that both Q1 and Q2 are blocked (zone B). If the pattern moves to the left, Q1 becomes unblocked first; Q2 will be first if the pattern moves to the right. At any "starting" position, it is easy to determine which direction the pattern is moving by simply noting which sensor changes state. If you open up an old computer mouse, you'll find that the sensing technique is similar.

Positioning, on the other hand, is "relative" rather than "absolute." If you begin at a known starting position, you have to keep track of how many pattern pulses have been generated and in which direction; not a difficult job for any computer program. Note that we can get four times the positioning information out of the pattern since there are four distinct zones to the pattern. If we have an encoder disc with 16 patterns, we can determine the position of the disc to one part in 64.

Construction. Building the IR Encoder consists of making an encoder disc, fabricating the circuit, installing the encoder disk on the device's shaft, and aligning the circuit to the disc.

You can lay out your own encoder-disc pattern from the information provided above, or simply make a photocopy of Fig. 3. The disc should be 2¼ inches in diameter. The center shaft-mounting area is designed for a ¼-inch shaft, but it can be adjusted to suit the shaft on which it will be installed.

Paste the disc pattern on a piece of stiff cardboard (index-card material will do) and cut out the sixteen equally-spaced black-pattern areas with a pair of scissors or a sharp modeller's knife. The shaft hole should be cut a bit smaller than necessary to allow for a press fit onto the shaft.

The circuit can be built on a piece of perfboard using standard construction techniques. A suggested layout is shown in Fig. 4. The only point to keep in mind is that the diodes and phototransistors should be aligned so that they point at each other. Be careful to

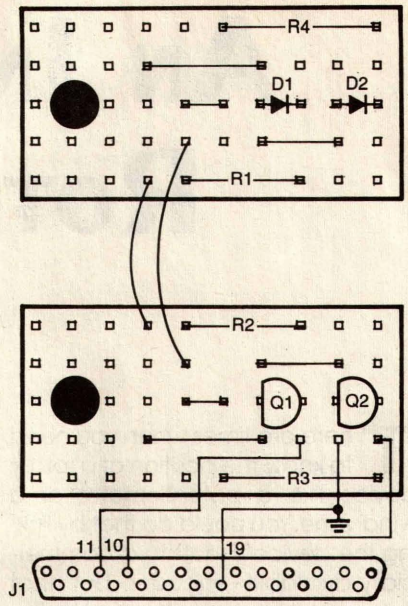


Fig. 4. The two boards for the IR Encoder can be built from perfboard; the positions of D1, D2, Q1, and Q2 should be the same on both boards.

check the polarities of the semiconductors before installing them; if one device is installed backwards you will have fits trying to figure out why the circuit doesn't work!

You can check out the operation of the diode by connecting it in series with a 330-ohm resistor to a 5-volt DC source. You should be able to measure a 1.2-volt drop across the diode. If not, reverse the diode and try again. To test the transistor, connect a 100,000-ohm

PARTS LIST FOR THE IR ENCODER

SEMICONDUCTORS

IC1—78L05 5-volt regulator, integrated circuit
Q1, Q2—IRD300 infrared phototransistor (Jameco 112176 or similar)
D1, D2—TLN100 infrared diode (Jameco 112150 or similar)

RESISTORS

(All resistors are ¼-watt, 5% units.)
R1, R4—330-ohms
R2, R3—100,000-ohms

ADDITIONAL PARTS AND MATERIALS

C1, C2—1-µF, 16-WVDC, electrolytic capacitor
J1—25-pin male connector
8–13-volt DC power supply, wire, index-card material, hardware, etc.

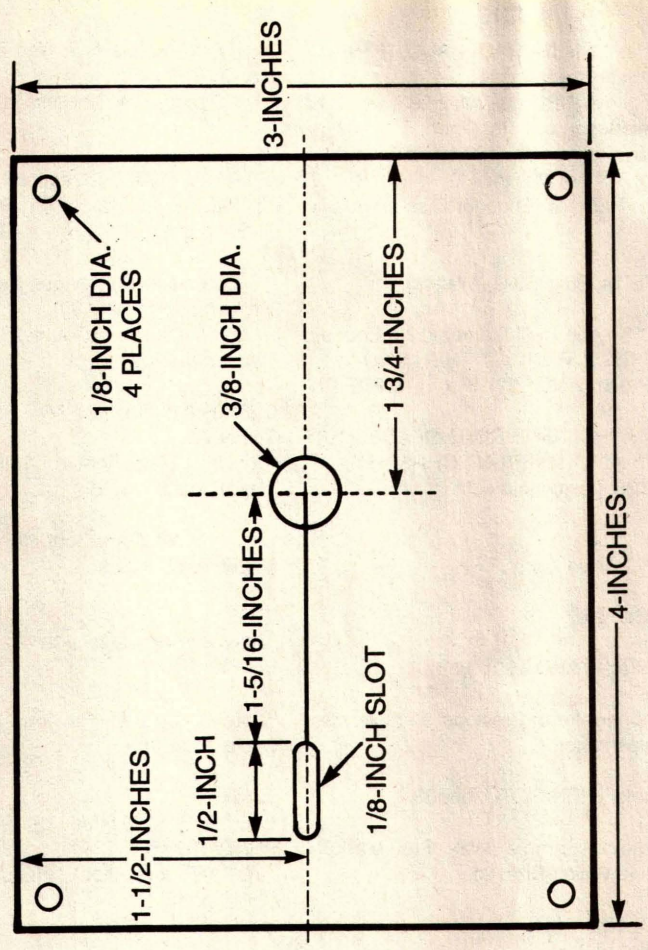


Fig. 5. The IR Encoder should be mounted on a plate for testing. An old potentiometer is mounted in the center hole; it makes an inexpensive shaft on a bearing.

resistor between 5 volts DC and the transistor's collector; connect the transistor's emitter to ground. Monitor the voltage across the transistor's collector-emitter leads; it should be at least 4 volts. When an energized diode is pointed at the phototransistor at a distance of about 1/8 inch, the collector-emitter voltage should drop substantially. Depending on how you are holding the two devices, the voltage drop can be anywhere between 0.1 and 1 volt. If you don't get those results, reverse the transistor leads and try again.

If you want to start by building a "demonstrator" unit before incorporating it into another project, a simple mounting base made from Masonite or another suitable material should be used. Suggested dimensions are shown in Fig. 5.

A 1/2-inch threaded spacer for a 4-40 machine screw secures the two boards together and keeps them a fixed distance apart. One of the screws goes through the slot in the mounting plate. Use a non-conducting washer to keep the lower board off of the mounting plate. With the two boards assembled, carefully adjust the position of each diode and transistor to make sure that they are not skewed to the left or right with respect to each other. Each diode and transistor should be as vertical as possible. The final assembly should look like Fig. 6.

Connect the circuit to a suitable power supply and wire up a connector as shown in Fig. 1. The connector wires should be long enough to reach your PC's parallel port.

Mount any standard potentiometer in the 3/8-inch hole so its shaft is on the top of the base. For a more effective demonstration, disassemble the potentiometer and modify the inside so the shaft can turn continuously. Push the encoder wheel onto the potentiometer's shaft. Adjust the position of the circuit boards so that the diode/transistor pairs are in the same relative position as shown in Fig. 2 and the unit points directly at the shaft.

Testing. A test program has been included in Listing 1; it is designed to run under Qbasic or Quick Basic. Connect the IR Encoder to your PC's parallel port and power supply. Position the potentiometer shaft so that a portion of the encoder disc is blocking the diodes. Run the application. The program will say that it is "Waiting...". When you move the potentiometer shaft so that a cutout is directly over the diode/transistor pairs, the "Waiting" message will be erased and one of the 16 position markers will change to a large white rectangle. As you rotate the shaft, the computer's position indicator will follow suit.

Understanding the Software. The program in Listing 1 is liberally commented to help make its logic understandable. Let's focus on a few of the more important portions.

Loop01 waits for the encoder disc to be positioned so that both transistors are conducting. When that condition is been met, loop02 is entered. There, the status of the module is obtained and stored in variable x. If there has been no change (x = xold), execution jumps to loop03 where the keyboard is checked to see if the user wants to exit the program. If no keypress is found, execution loops back to loop02 for another look.

When a change has been detected, the program looks to see if the previous value was 128 (indicating the previous sample was a

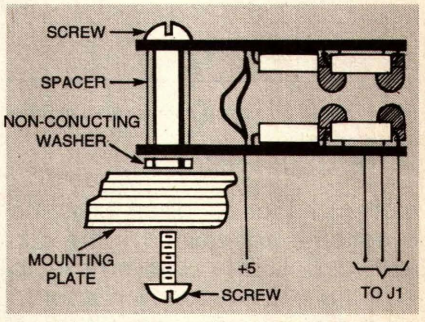


Fig. 6. Mount the two boards together with a threaded spacer and screws. The diodes and transistors need to be aligned with each other exactly. Note that the bottom screw mounts the Encoder to the mounting plate.

LISTING 1

```
REM ** Encoder Demonstration
REM ** ENCODER.BAS
REM ** V990222
REM
CLS : DEF SEG = 64: DEFINT P, X
ad0 = 888: ad1 = 889
DIM x(16), y(16)
LOCATE 1, 15: PRINT "ENCODER MODULE DEMONSTRATION (Press ANY Key to Exit)"
LOCATE 2, 1: PRINT STRING$(80, 220)
'
'Define the X and Y Locations of the Encoder's Rotary Display.
x(1) = 7: y(1) = 40
x(2) = 8: y(2) = 47
x(3) = 10: y(3) = 52
x(4) = 12: y(4) = 54
x(5) = 14: y(5) = 55
x(6) = 16: y(6) = 54
x(7) = 18: y(7) = 52
x(8) = 20: y(8) = 47
x(9) = 21: y(9) = 40
x(10) = 20: y(10) = 33
x(11) = 18: y(11) = 28
x(12) = 16: y(12) = 26
x(13) = 14: y(13) = 25
x(14) = 12: y(14) = 26
x(15) = 10: y(15) = 28
x(16) = 8: y(16) = 33
'
'Poff is Lower Case "o". Pon is a Graphics Block.
'
poff = 111: pon = 219
'
'Display the 16 Points of the Rotary Encoder Disk.
'
FOR i = 1 TO 16
 LOCATE x(i), y(i): PRINT CHR$(poff);
NEXT i
'
REM***** Logic For Obtaining Position and Direction.
REM
REM  Pin 10 is INP(AD1) AND 64.
REM  Pin 11 is INP (AD1) AND 128 (with Pin 11 response inverted).
REM  So, get INP(AD1) AND 192, which is the combination of both. Then,
REM  Marker = 128. To Left of Marker = 192. To Right of Marker = 0
REM  In-Between Encoder Disk cutouts = 64
'
LOCATE 14, 35: PRINT "Waiting...";
loop01:
REM***** Loop Until Marker (128) Found.
a$ = INKEY$: IF a$ <> "" THEN END
x = (INP(ad1) AND 192): IF x <> 128 THEN GOTO loop01
LOCATE 14, 35: PRINT SPACE$(10): LOCATE x(1), y(1): PRINT CHR$(pon);
xold = 128: positionold = 1
'
loop02:
REM***** Main Loop
'
'Get A Sample
'
x = (INP(ad1) AND 192)
'
'No Change from Previous Sample. Go Back for Another.
'
IF x = xold THEN GOTO loop03
'
'If Previous Sample Was the Marker, Determine Which Direction
'
IF xold = 128 THEN
  direction = 0
  IF x = 0 THEN direction = -1
  IF x = 192 THEN direction = 1
END IF
'
'If Current Sample is Not the Marker, Try Again.
'
IF x <> 128 THEN xold = x: GOTO loop03
'
'Marker Found.
'
'   If Previous Sample Was To the Right of Marker (0), and
'      Direction is Clockwise (1), Increment Position by 1.
'
IF (xold = 0) AND (direction = 1) THEN
  position = positionold + 1: IF position = 17 THEN position = 1
'
'   Otherwise, if Previous Sample Was To the Left of Marker (192),
'   and Direction is CounterClockwise (-1), Decrement Position by 1.
'
ELSEIF (xold = 192) AND (direction = -1) THEN
  position = positionold - 1: IF position = 0 THEN position = 16
'
'      If Neither Condition Exists, No Movement In Position.
'
ELSE
  xold = x: GOTO loop03
END IF
'
'Store Sample As Previous and Re-Draw Circle and Block
'
 xold = x
 LOCATE x(positionold), y(positionold): PRINT CHR$(poff)
 LOCATE x(position), y(position): PRINT CHR$(pon)
 positionold = position
'
loop03:
'
'Check For Keypress Signaling Desire to End
'
a$ = INKEY$: IF a$ <> "" THEN END
'
'No Keypress, so Go Back for More.
'
GOTO loop02
```

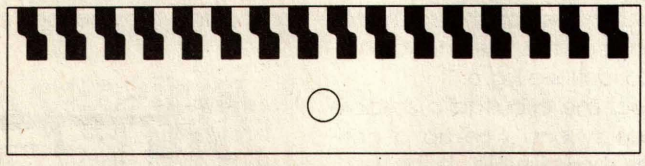


Fig. 7. The IR Encoder is not restricted to rotary applications; this pattern can be used for a linear arrangement.

marker). If that condition exists, the direction is determined. If the current value is 0, the direction is set to −1. If it is 192, the direction is set to +1. If that condition doesn't exist, then the current value is stored as the previous value and the program again goes to loop03 to check for a keypress.

If the current value is 128 (indicating a marker) and the previous value wasn't, the program proceeds to the code following the "Marker Found." remark. The IF... THEN... ELSE statements identify in which direction the shaft moved and increment or decrement accordingly.

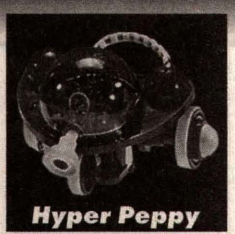
The complete source code (less remarks) is only 55 lines long. Without setting up variables for displaying the position on the screen, the code that remains is only 35 lines long. You can use that code as the basis for your own applications.

Obviously, the results that you get depend strongly on the alignment of the diodes and transistors, and the position of the module on the base. Experiment with all of those variables for the best results. In actuality, there's no reason why the encoder has to be used with a round encoder disc. You can use the same cutout areas spaced linearly to make a linear movement encoder "strip." Such a strip is shown in Fig. 7.Ω

SUPPLEMENT TO ELECTRONICS NOW NOVEMBER 1999

Electronic SHOPPER®

BUY FOUR AND GET ONE FREE*

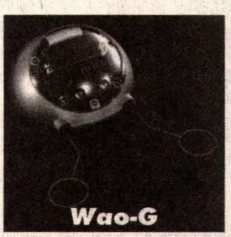


Hyper Peppy
OWI-969K: $24.95
Fast, 3 wheeled robot with a touch/sound sensor

Line Tracker
OWI-963K: $49.95
Follows a black line with its infrared sensor

Triple Action Solar Car
OWI-685: $39.95
High powered 1.4V – 350mA solar cell included

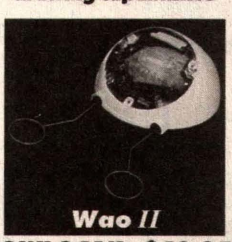
Robotic Arm Trainer
OWI-007: $69.95
Highly acclaimed award winner



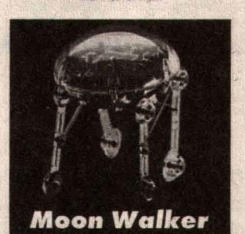
Wao-G
OWI-968K: $89.95
48 fuzzy logic programming steps and drawing capabilities

S-Cargo
OWI-936K: $36.95
Sound sensor controls it to spin, stop, and go forward

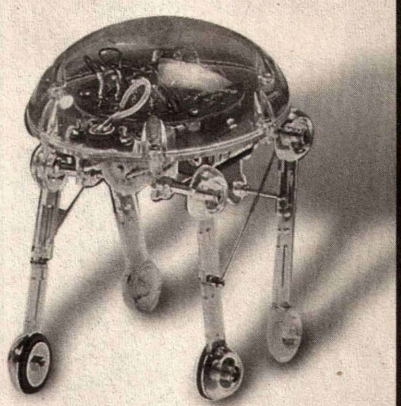
Spider
OWI-962K: $49.95
Infrared sensor detects solid obstacles in its path



Wao II
OWI-961K: $69.95
Learn how to program in simple Basic language



Moon Walker
OWI-989K: $34.95
Will walk when it detects a change in light



Moon Walker

*** While supplies last, purchase any four of the robotic kits shown at left, and receive a Moon Walker Robotic Kit absolutely FREE!**

TECHNOLOGY · EDUCATION · SCIENCE

ROBOTIKITS™ DIRECT

17141 Kingsview Ave. Suite B, Carson, CA 90746
Phone: (310) 515-6800
Fax: (310) 515-0927
E-mail: owi@ix.netcom.com
Web Page: www.robotikitsdirect.com

MasterCard VISA

Order M – F:
8a.m. – 4p.m. PST

CIRCLE 334 ON FREE INFORMATION CARD

Locate Bad Caps Fast

IN-CIRCUIT!!

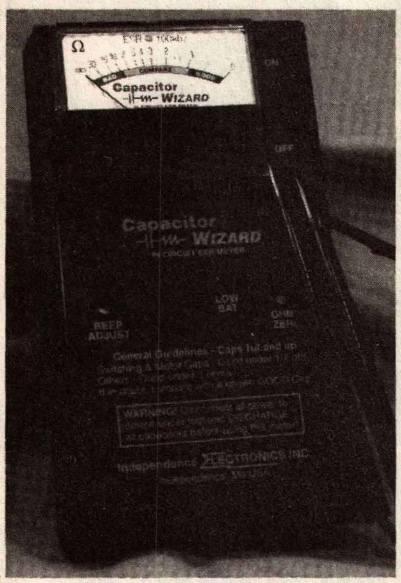
Lower Costly Service Time
Reduce Costly Callbacks
Tame **"TOUGH DOGS"** in Minutes

INSIST on the *ORIGINAL*

Capacitor ™ WIZARD

IN-CIRCUIT ESR METER

Large, easy to read analog meter makes for the fastest, most accurate testing available! Unique "Cap GOOD" beeper makes testing caps In Circuit ***virtually INSTANTANEOUS!!*** Needle sharp ***GOLD PLATED*** stainless steel probes provide FAST and POSITIVE connection to both AXIAL and RADIAL caps.



Technicians say the Capacitor Wizard is ***"the most cost effective instrument on their workbench!"***

ONLY $179.95
800-394-1984
For More Information goto
www.heinc.com/ieinc/cwinfo.htm

30 DAY MONEY BACK GUARANTEE
Order today! You Can't Lose!!!

Made in the USA!

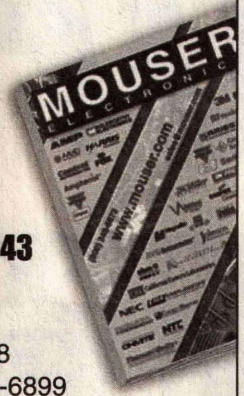
c UL us LISTED MEASURING EQUIPMENT 20mm

Howard Electronic Instruments, Inc.
6222 N. Oliver, Kechi, KS 67067
316-744-1993 International
316-744-1994 Fax
Email: sales@heinc.com

MasterCard

www.mouser.com

Subscribe, download, or view catalog online!



800-992-9943

817-483-6828
Fax: 817-483-6899

catalog@mouser.com

958 N. Main St., Mansfield, TX 76063

MOUSER ELECTRONICS

CIRCLE 318 ON FREE INFORMATION CARD

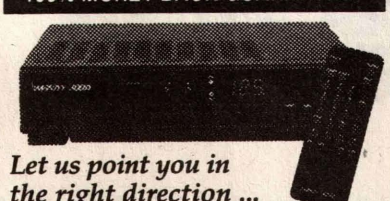
Call Today And SAVE! **Unbeatable PRICES!**

CABLE TV

DESCRAMBLERS
CONVERTERS · FILTERS
VIDEO STABILIZERS

FREE ➤ 30 Day Trial
FREE ➤ Product Catalog
FREE ➤ 1 Year Warranty

100% MONEY BACK GUARANTEE



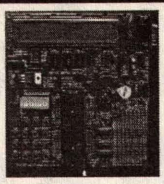
Let us point you in the right direction ...

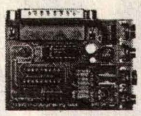
Arrow Technologies
Omaha, Nebraska

TOLL FREE
888-554-ARROW
888-554-2776

Low Cost PICmicro Tools

New! PIC-X1 Experimenter/ Lab Board
$49.95 to $199.95

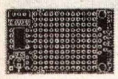




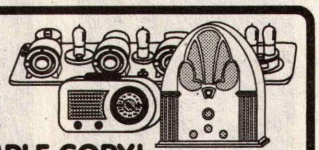
EPIC Pocket PICmicro Programmer - $59.95

Program PICmicros in **BASIC!**
PicBasic Compiler - $99.95
PicBasic Pro Compiler - $249.95

PICProto Boards make prototyping with PICmicros easy - $8.95 to $19.95



microEngineering Labs, Inc.
Box 7532 Colorado Springs CO 80933
(719) 520-5323 fax(719) 520-1867
http://www.melabs.com



FREE SAMPLE COPY!

ANTIQUE RADIO CLASSIFIED

Antique Radio's Leading Monthly Magazine

Classifieds - Ads for Parts & Services
Articles - Auction Prices – Flea Market Info.
Early Radio & TV – Hi-Fi – Ham Equip.
Art Deco – Telegraph – 40s & 50s Radios
Also the source for Books & Price Guides

1-Year: $39.49 ($57.95 by 1st Class)
6-Month Trial - $19.95. Foreign - Write.
Call: 978-371-0512 – Fax: 978-371-7129
A.R.C., P.O. Box 802-L33
Carlisle, MA 01741
Web: www.antiqueradio.com

Max '99' $459.90

Used world wide for research!

* Three 12 inch diameter decks
* 30 lbs payload capacity
* HC11 microprocessor w/ 32k ram
* Basic, Forth and 'C' programming lang.

Zagros Robotics
PO Box 460342
St. Louis, MO 63146-7342
(314)768-1328
http://www.zagrosrobotics.com
info@zagrosrobotics.com

Attention: MIS Directors & PC Repair Technicians

Daily system problems & Y2K can make a tech's life hell...

Award Winning

Windows 95·98·NT compatible

GSA Approved

1993 BYTE Pournelle's User's Choice Award

Micro 2000's Diagnostic Toolkit™ gives you fast, 100% accurate PC diagnostic tools

This is the **Universal Diagnostics Toolkit**™ that technicians around the world rave about. Contains award-winning **Micro-Scope**™ **7.0** diagnostic software with over 125 testing routines that bypass the system OS for 100% accurate results. Tests all RAM, I/O ports, keyboard, floppy & hard drives, CD, mouse, cables, monitor, speakers, peripherals, etc. Works with any IBM compatible PC and any OS (Windows 95/98/NT, DOS, OS/2, Unix, Linux, etc.). Free downloadable web updates.

The Toolkit also contains award-winning **POST-Probe**™ PCI/ISA card reader that lets you instantly debug PCs that won't boot. No more trial-and-error. Simply plug the card into any ISA, EISA or PCI slot, boot your PC and **POST-Probe** displays what's wrong on its onboard LEDs. The Toolkit is used by professional technicians at AT&T, Toshiba, DEC, Hewlett Packard, Honeywell, and the U.S. Army, Navy & Air Force. See our web site for technical details or call for more info. Call for current pricing and upgrades.

Centurion™ makes your current PCs Y2K compliant NOW!

Your job depends on finding the right Y2K solution that will protect your company's valuable data. Don't waste megabucks on new PCs, and don't trust *"software fixes"* for the Y2K problem which are open to viruses, disk crashes & corruption leaving your PCs unprotected. Upgrade your ***hardware*** with our inexpensive **Centurion**™ Y2K rollover card (only $69.95 with volume discounts available). Instantly corrects BIOS and RTC problems for hassle-free computing. Used by U.S. govt. agencies, the U.S. military, banks and large businesses around the world. Works with 386, 486, Pentium® & compatible processors. Just plug it in—it's user installable in minutes. No special tools required. Fully tested & certified by KeyLabs. Onboard 10-year lithium battery ensures long life. Download FREE Y2K testing software.

ONLY $69.95

GSA Approved

CE

KeyLabs TESTED

Download FREE Y2K Test Software

Call for business/government/education volume discounts. Dealer inquiries welcome.

Call 1-800-864-8008
(818) 547-0125 or Fax (818) 547-0397
www.micro2000.com
netsales@micro2000.com

© 1999 Micro 2000, Inc. All Rights Reserved. MICRO 2000, MICRO-SCOPE, POST-PROBE, CENTURION and UNIVERSAL DIAGNOSTICS TOOLKIT are trademarks of Micro 2000, Inc.

Micro2000™
KEEP YOUR PCs UP & RUNNING

CIRCLE 236 ON FREE INFORMATION CARD

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radiotelephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School

This proven course is easy, fast and low cost! GUARANTEED PASS—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 210

COMMAND PRODUCTIONS
FCC LICENSE TRAINING, Dept. 210
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

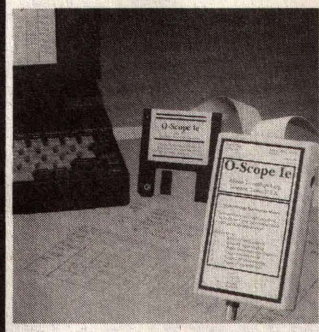
DIGITAL STORAGE

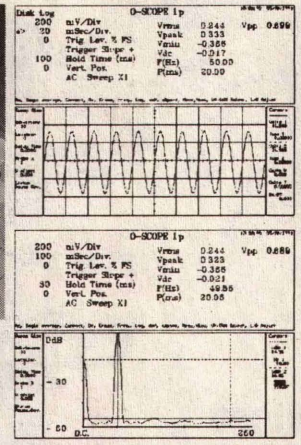
OSCILLOSCOPES

WITH SPECTRUM ANALYZER, DVM, FREQ. COUNTER, AND DATA LOGGER.

from **$189.**

PORTABLE MODULES CONVERT PC'S INTO MULTIPURPOSE TEST AND MEASURING INSTRUMENTS.





MasterCard VISA AMERICAN EXPRESS

Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

FEATURES:
- PORTABLE UNITS TO 25 MHz
- USES PRINTER PORT
- USES STD. PROBES

OPTIONS:
- PROBE SETS
- AUTOMOTIVE PROBES
- BATTERY PACKS
- SOFT & HARD CASES

O-Scopes Made in U.S.A. **Picos Made in U.K.**
Same Day Shipping
Includes Cable, Software & Manuals

O-Scope Ip (DC-50KHz, single trace) ..... $189.
O-Scope II (DC-500KHz, dual trace) ..... $349.
PICO (ADC 200/20) (DC-10MHz, dual trace) ..... CALL
PICO (ADC 200/50) (DC-25MHz, dual trace) ..... CALL

PICO pc based data loggers from $99.

Shipping within U.S. UPS Ground $7.50 (Second day $11.50)

SEND CREDIT CARD INFO., M.O., or CHECK, OR CALL

1-800-980-9806

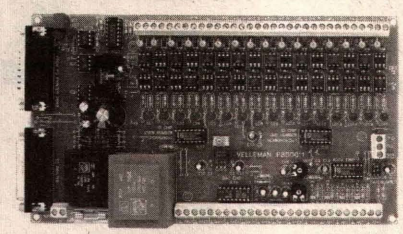
Allison Technology Corporation

2006 FINNEY-VALLET, ROSENBERG, TX 77471
PHONE: 281-239-8500 FAX: 281-239-8006

http://www.atcweb.com

velleman Computer Interface Kits

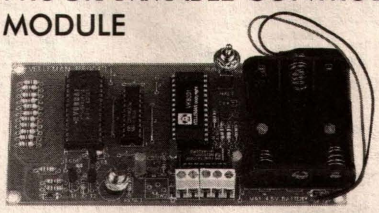
K8000 PC INTERFACE CARD KIT
IDEAL FOR HOME AUTOMATION AND PROCESS CONTROL



$149.99

Connects to the parallel port of an IBM compatible PC (optically isolated). 16 digital in-/outputs. 8+1 analog outputs. 4 analog inputs. Daisy-chain up to 4 units for extended possibilities. Examples included for MSDos™, Win3.11™, Win95/98™ under Qbasic, Turbo Pascal and C++. Power supply : 110-125VAC 60Hz
Digital outputs : open collector 50mA/30VDC max. Digital inputs : min 5V/5mA, max. 20V/40mA Analog outputs : 6 bit resolution / Max. output current : 6mA / Max output voltage : 11.5V (adjustable). Precision analog output : 8 bit resolution / Max. output current : 2mA / Max output voltage : 4.5V (adjustable). Analog inputs : 8 bit resolution / Max. input voltage : 5V / Input impedance : ±50Mohm

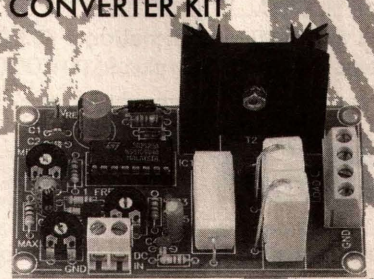
K8001 INDEPENDENT PROGRAMMABLE CONTROL MODULE



$99.99

For use with the K8000 computer interface card
Allows the stand alone use of the K8000 card. Assembler-like instruction set. 2500 step memory. Battery back-up. Comes with compiler and examples on disk. Power is supplied by the K8000

K8004 DC TO PULSE WIDTH CONVERTER KIT

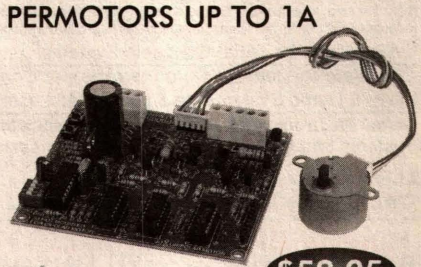


$22.99

Allows very efficient control of DC motors, heaters or lighting.

Ideal for use with the K8000 computer interface card. Broad operating voltage range. High current capability. Short circuit and overload protected. Control by means of a potentiometer or an external voltage. Maximum output current : 6.5A Power supply : 8 to 35VDC. Control voltage : 2.5 to 35VDC

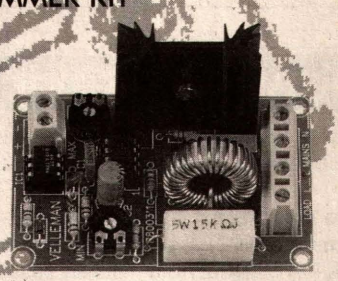
K8005 STEPPER MOTOR CARD KIT
FOR UNI- AND BIPOLAR STEPPERMOTORS UP TO 1A



$59.95

Needs the K8000 computer interface card. Connect up to 16 cards to a single K8000. With routines for TurboPascal for DOS™, Qbasic and Visual basic.
Adjustable speed, direction and step mode. Emergency stop feature. Manual test switches provided. Comes with one high precision motor. Power supply : 7 to 25VDC or AC / 1.5A max.

K8003 DC CONTROLLED DIMMER KIT



$24.99

Control power circuits with a safe DC voltage
Control voltage : 0 to 10VDC. Control voltage and load are optically separated. Ideal for computer interfacing projects with K8000. Power supply : 110-125VAC / 60Hz. Max. load : 3.5A

Available at :

Tech America

Tel : (800) 877-0072

velleman

7415 Whitehall Street Suite 119
Fort Worth, TX 76118
(817) 284-7785 F : (817) 284-7712
www.velleman.be email : velleman@earthlink.net

Questions ? Contact us for a list of US distributors or to get your *FREE* catalogue

CIRCLE 282 ON FREE INFORMATION CARD

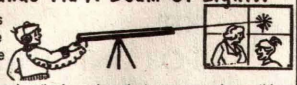
AMAZING PRODUCTS! INFORMATION UNLIMITED

BOX 716 AMHERST, N.H. 03031 adpe699o

VISIT OUR "ACTION" WEB SITE@ http://www.amazing1.com

Laser Window Listener

Access Internal Sounds Via A Beam Of Light!!



Remarkably simple concept uses a beam of laser light to illuminate a window acting as a microphone vibrating to the sounds and reflecting back to a sensitive filtered optical receiver that now reproduces this modulated light back into the actual sounds as heard thru a set of headphones.

LWB9 Plans for Three Complete Systems.....**$20.00**

Complete System for Demonstration of Concept

LWB60 Demo System with 5mw VisRed Laser..**$159.95**

Below Electronics for Two High Performance Infra Red Systems Shown Built From Above LWB9 Assembly Plans

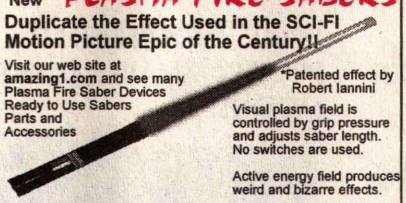
LLR40 Optical Receiver/Processer.....**$199.95**

CWL10 10 mw Infra Red Class IIIB Laser.....**$149.95**

All New PLASMA FIRE SABERS

Duplicate the Effect Used in the SCI-FI Motion Picture Epic of the Century!!

Visit our web site at **amazing1.com** and see many Plasma Fire Saber Devices Ready to Use Sabers Parts and Accessories



*Patented effect by Robert Iannini

Visual plasma field is controlled by grip pressure and adjusts saber length. No switches are used.

Active energy field produces weird and bizarre effects.

Specify available colors of *Photon Blue, Neon Red, Starfire Purple,and Phaser Green.*

PFS36K Kit of 36" Active Length....**$79.95**

Please add $20.00 for special handling of above

PFS26K Kit of 26" Active Length....**$59.95**

Please add $10.00 for special handling of above

PFS15K Kit of 15" Active Length....**$29.95**

FM Transmitter Kits

1. Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter
2. 1 Mile+ Phone Transmitter
3. Line Powered Phone Transmitter Never Needs Batterеies!
4. Tracking/Homing Beacon "Beeping Transmitter"
5. Video/Audio Rebroadcaster+1 Mile
6. TV/FM Radio Disrupter Neat Prank!!! Discretion Required

Includes Tricks Using Wireless Devices

COMBOX Above 6 Kits/Plans...**$59.95**

COMBOP Above 6 Plans Only..**$10.00**

Kinetic Electric Gun

Pioneer a Futuristic Weapon

JOIN THE RESEARCH EXCITING PROJECT!!

500 Joules Energy Storage
Constant Current Charging
Triggered Spark Switch
Ballistic Velocities
Handheld, Battery Operated
Labeled"Dangerous Product"

EGUN1 Plans.....**$20.00**

All Parts are Individually Available

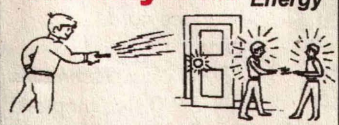
250 KV Tesla Coil

10-14" Explosive Bolts of Lightning!

Transmits Energy, Ion Motors Anti Gravity.
Size - 20"H x 8" Square
Weight - 25 Pounds
Input - 115 VAC/2Amps
See in "Action" on web ***www.amazing1.com***

BTC3 Plans.....**$15.00**
BTC3K Kit/Plans.....**$349.95**
BTC30 Ready to Use.....**$449.95**
BTC4 Plans 30" Sparks.....**$20.00**

Ion Ray Gun *Projects Energy*



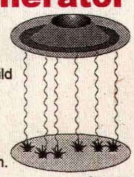
Star Wars Technology Demonstrates Weapons Potential, Force Fields, IonMotors, Antigravity etc. ***Projects electric shocks without contact!!*** Conduct many weird and bizarre experiments

IOG7/9 Plans.....**$10.00**
IOG7K Kit/Plans.....**$99.95**
IOG70 Assembled/Tested.....**$149.95**

Higher Powered Device

IOG9K Kit/Plans.....**$129.95**
IOG90 Assembled/Tested.....**$199.95**

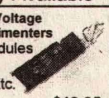
Gravity Generator



Demonstrates a unique phenomena of electrical reactions that produce the effect of "anti-gravity". You build a small mock space ship from simple materials and use our power supply for energizing. Excellent demonstration of a fascinating method of levitation.

GRA3 Plans with Book.....**$20.00**
GRA3K Pwr Sup Kit/Plans/Book.....**$99.95**
GRA30 Assmbled with Book.....**$149.95**

Attention High Voltage Experimenters



Battery Powered Mini Sized Modules For Research In:Hovercraft, Ion Guns, Force Fields, Shockers Etc.

MINIMAX4 4KV@10ma.....**$19.95**

500,000 VOLTS!

SIZZLER Produces Explosive Stunning and Stopping Power Intimidatingly Effective to 20'

SIZZ500 Complete..**$79.95**

Shock Force Field Vehicle Object Electrifier

Hand shock balls,wands. Mini circuit is easily hidden Great payback for those wise guys.

SHK1K Kit/plans.....**$19.95**

1 800 221 1705 Orders Only! **Fax 1 603 672 5406** **Information 1 603 673 6493** ***Free Catalog on Request***

Pay by MC,VISA,Cash, Check, MO, COD. Please Add $5.00 S&H plus $5.00 if COD. Overseas Please Contact for Proforma

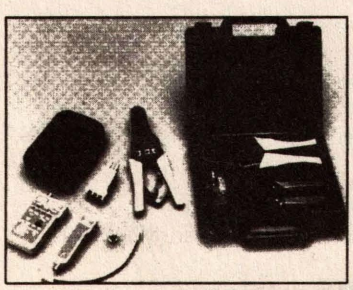
Network Service Tool Set

Popular installation and service tools for networks, modems and telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin Ethernet (BNC), 8-position Token Ring, AT&T 258A and EIA/TIA 568A/B. Automatically scans cables for continuity, wiring sequence and polarization. Tests STP cable ground. Testing installed cables is easy with Remote Terminator and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

Order No. 55625 $197.00

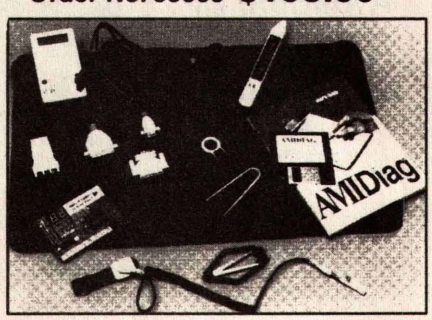


PC Service Tool Set

Contains all tools needed to troubleshoot & service IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester
- Serial Adapter
- Serial & Parallel Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

Order No. 55000 $198.00



PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

Order No. 55555 $89.00

Network Installation Tool Set

- Network Tool Set 55625 without the Multi-Network Cable Tester.

Order No. 55600 $99.00

Call for your FREE Catalog

Graymark®

P.O. Box 2015 Tustin, CA 92781

http://www.labvolt.com

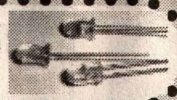
CALL TODAY!

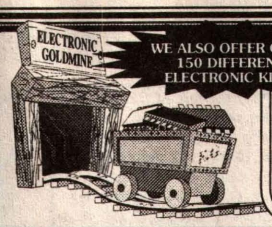
800-854-7393

VISA MasterCard AMERICAN EXPRESS Cards DISCOVER NOVUS

CIRCLE 329 ON FREE INFORMATION CARD

FREE With your order you'll receive a FREE catalog, and if you mention this Ad, you'll receive a FREE bag of 10 assorted LEDs.
(One free bag of LEDs per order, offer expires 11-30-99)





WE ALSO OFFER OVER 150 DIFFERENT ELECTRONIC KITS.

ELECTRONIC GOLDMINE
PO Box 5408
Scottsdale, AZ 85261

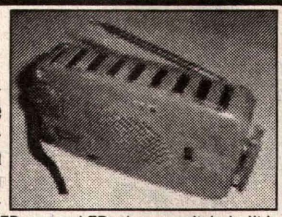
http://www.goldmine-elec.com

NOTE: All items subject to prior sale; All prices expire 11-30-99

For **Phone Orders** Call: **800-445-0697**
or **Fax** Your Orders to: **(480) 661-8259**
For a **Free Catalog** Call: **800-445-0697**
e-mail: goldmine-elec@goldmine-elec.com
Foreign catalog request: send $5.00

Minimum Order: $10 (plus min. $5 Shipping and Handling). We accept MasterCard, Visa and personal checks, however, we cannot accept personal checks on orders outside the U.S. **Minimum Foreign Order Amount:** $50 (plus a minimum $10 S&H)

Y2K COMPLIANT SOLAR POWERED / DYNAMO AM/FM RADIO



This radio is great for emergencies, camping, vacation travel, remote living, etc. It does not require batteries to operate because it has built in nicad rechargeables that can be recharged by the sun or a built in hand crank. The sound from the built in speaker is good quality and has room filling volume. These are blue in color and feature a tuning LED, power LED, charge switch, built in dynamo crank, built in solar panel, AM/FM switch, tuning control knob, volume control, carry strap, built in extendable antenna and a battery compartment for 2AA batteries (not included and not needed–for backup use only). Brand new in retail box–nothing else to buy. Makes a great gift for anyone!

G1539 $29.95 ea.

CALL, E-MAIL, WRITE OR FAX US FOR YOUR FREE COPY OF OUR 96 PAGE CATALOG CONTAINING ALMOST 5,000 PRODUCTS!

METAL LOCATOR COIL ASSEMBLY

Unique

This is the coil head assembly from a small metal locator. It consists of a 7 1/16" plastic head which has a coil assembly inside connected to a 4 lead + shield flexible insulated cord. Head has a 16" aluminum pole attached by means of a wing nut. Sorry, no specs or data available. Removed from new equipment by a manufacturer who only wanted the metal locator main circuit board and case.

G1543 $6.00 ea.

DELCO AUTO SPEAKER

Made for use in many cars, this speaker features a built in 220uF 25V bipolar capacitor to allow a certain frequency range to pass into the speaker (can be bypassed if desired). Features a 2 3/8" ceramic magnet and a 4" x 6" frame. Impedance 4Ω. Brand new with dust cover. Sorry, power rating unknown.

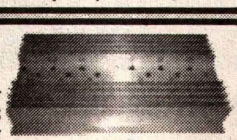
G1549 $2.00 ea.

AB MOD POT®

High quality Allen Bradley Mod Pots® with standard panel mount 3/8" bushing and panel mount nut. Features screwdriver, adjust shaft and gold plated pins for hookup. AB part # 70MIN024S.

MODEL 70MIN024S103U (10K) G1544 $1.00 ea.
MODEL 70MIN024S104A (100K) G1545 $1.00 ea.

GIANT T03 HEAT SINK



Perfect for high power audio amplifiers and high power transmitters or power supplies. Made of solid anodized (gold color) aluminum. Size is 8" Long x 4 3/4" Wide x 1 1/4" Thick. Predrilled for 6 T03 metal case semiconductors. Brand new!

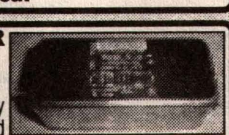
G1547 $10.00 ea. Wow!

50FT ALL-WEATHER MARINE POWER CORD

High quality 3 conductor grounded 14 gauge heavy duty blue power cord made by West Marine Dockmates™. Repels moisture, is abrasion resistant and resists deterioration from the sun. Flexible high quality power cord for all dock-side power needs is rated AWG 14/3 SJTW-A 15amp 125V. Has 3 prong male on one end and 3 prong female on other. Brand new!

G1540 $15.95 ea.

SCHAFFNER FN2080-12-06 LINE FILTER



High quality heavy duty EMI filter is rated 110/250VAC 50-60HZ@12amps. Brand new. Size 5 1/8" x 2 3/16" x 1 3/4".

G1546 $3.49 ea.

SMALL 12VDC 10AMP RELAY

Small 12VDC relay by MSD Inc. features SPST 10amp 250VAC contacts. Size only 3/4" L x 3/8" H x 15/32" W. Sealed case. Brand new high quality.

G1541 $1.95 ea.

RING SHAPED RARE EARTH COBALT SUPER MAGNET

This 11/16" Dia O.D. with 3/16" Dia. I.D. Super Magnet is only 1/16" thick yet is very powerful for its size. Worth much more than our price!

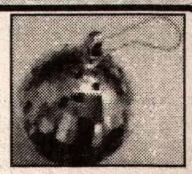
G1548 $1.50 ea.

OUR TINIEST MOTOR

These are brand new motors made for the "vibrator" function in pagers. The body is only 9/16" long x 1/4" dia. Attached to the shaft is a "D" shaped weight, which you can insert into the center of a small plastic wheel, and you have a drive unit for a tiny robot that you can power from a hearing aid battery, a solar cell, etc.

G1552 $1.49 ea. • 100/$100.00 Wow!

SAFETREE HEAT SENSOR ALARM ORNAMENT



This is one of the neatest products we have seen in years. This holiday ornament made by Quorum® is also a heat sensitive alarm that you can hang on your Christmas Tree. If there is a fire, the Safetree will emit a VERY LOUD (90 dBA per meter minimum) alarm when it detects a temperature above 122°F. The unit features very sophisticated IC and transistor circuitry driving a loud Piezo Buzzer. The Safetree Heat Sensor Alarm Ornament operates 24 hours a day for 21 days on one 9-volt battery (not included). This attractive ornament is the perfect addition to your home for this holiday season. The ornament is silver in color and is about 2 1/2" in diameter. Brand new in manufacturer's box, complete with instructions. We are offering this unique holiday item at an extremely low price. Hurry and get yours today!

G9880 ~~$5.95 ea.~~ Sale! $2.95 ea.

Compare at $14.95

CALLER ID BLOWOUT

These are used, good condition caller ID units with a large LCD display which shows name and phone # of caller (Unless blocked or out of area). Stores info on up to 72 callers. Operates on one 9V battery (not included). Call phone company to start caller ID service if you don't already have it. Hurry, don't miss out on this value!

G1550 SALE! $2.00 ea. Wow!

"AS IS" CORDLESS TELEPHONE WITH CALLER ID

High tech cordless phone stores up to 50 names and numbers on the built in caller ID display. We do not test them and we do not have any instructions for use so we are selling them "as is" only. Units are missing battery, phone antenna and a 9V 150ma adapter for the base unit. Please no returns. These were probably $200 phones!

G1551 White ~~$8.95 ea.~~ SALE! $5.95

• THE ELECTRONIC GOLDMINE: PO BOX 5408 SCOTTSDALE AZ 85261 •
TOLL FREE ORDER LINE: 800-445-0697 • FAX: (480) 661-8259 • ALL OTHER CALLS: (480) 451-7454

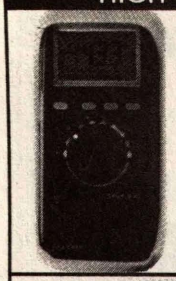
CIRCLE 241 ON FREE INFORMATION CARD

ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT

Visit www.alfaelectronics.com for complete info

Call 1-800-526-2532 for Order and Free Catalog



DMM

DMM-899 ($179.00): true rms, AC/DC (V,A), Ω, bar graph, freq, capac., dBm, logic, diode

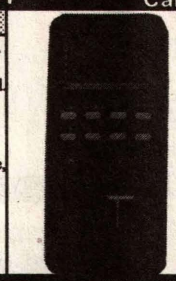
DMM-23T ($99.95): 4½ digit, true rms, high resol. (10µV, 10nA, 10mΩ), hFE, diode, contin.

DMM-20 ($74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle

DMM-122 ($59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity

DMM-123 ($44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity

DMM-10 ($19.95): 3½ digit, DC/AC V, Ω, hFE, diode, signal output(+3V,-0.5Vsq.,50%duty)



LCR/COUNTER

CAP-15 ($49.95): 3½ digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment.

LCR-24 ($119.95): 0.1µH-200H, 0.1pF-2000µF, 0.01Ω-20MΩ, diode test. *New Model.*

LCR-131D ($219.95): autorange, 0.1µH-10kH, 0.1pF-10mF, 1mΩ-10MΩ, Q Factor, serial/parallel, 120Hz/1kHz testing mode.

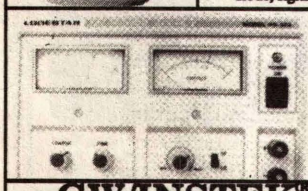
FC-1200 ($129.95): 1.25GHz Handheld, 8 digits display, 10ppm accurary, sensitivity 5mV (130-350MHz), 30mV (440MHz)

FLUKE

12B	$ 94.95
70-III	$ 99.00
73-III	$125.00
75-III	$155.00
77-III	$173.00
79-III	$195.00
87-III	$325.00
92B-III	$1,445
96B-II	$1,695
99B-III	$2,095
105B	$2,495
123-III	$1,130
863E	$555
867B	$740

SPECIALTY

• AC Current Probe	$34.95
• DC/AC Current Probe	$79.95
• Mini AC Clamp	$59.95
• AC Clamp w/temp	$89.95
• DC/AC Clamp	$109.95
• Thermometer	$69.95-$89.95
• IR Thermometer	$189.95
• Sound Level Meter	$169.95
• Tachometer	$169.95-$219.95
• EMF Tester	$69.95
• Pressure Meter	$299.95
• Watt Meter	$129.95
• High Voltgae Probe	$59.95
• pH Meter	$79.95
• Light Meter	$79.95-$89.95



Single Output DC Power Supplies

- Constant current, constant voltage mode
- Short Circuit and overload protected

Analog Meters Display	*Digital Volt, Analog Current*
PS-303 ($159.00) 30V/3A	PS-8200 ($179.95) 30V/3A
PS-305 ($219.95) 30V/5A	PS-8201 ($239.95) 30V/5A
PS-8112 ($399.95) 60V/5A	*Digital Volt & Current Display*
PS-1610 ($289.00) 16V/10A	PS-8300 ($199.95) 30V/3A
PS-8107 ($399.95) 30V/10A	PS-8301 ($259.95) 30V/5A

Triple Output

- Independence or Tracking operation
- Parallel to double current output (PS-8102 & PS-8103 only)

Triple Output (Analog displays)

PS-8102 ($399.95) 30V/3A/30V/3A

PS-8103 ($489.95) 30V/5A/30V/5A

Digital Displays

PS-8202 ($499.95) 30V/3A/30V/3A

PS-8203 ($549.95) 30V/5A/30V/5A

AUDIO/RF/FUNCT. GEN.

RF Generator • SG-4160 ($124.95) 100kHz-150MHz sinewaves in 8 ranges

• SG-4162AD($229.95) with 6 digit counter

Audio Generator • AG-2601 ($124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave

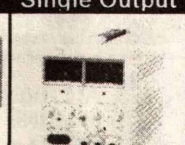
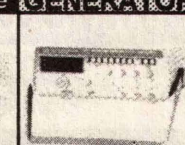
• AG-2603AD ($229.95) with 6 digit counter

Function Generator • FG-2100A ($154.95) 0.2Hz-2MHz,5mV-20V_{pp}

• FG-2103 ($329.95) *Sweep* 0.5Hz-5MHz

GW/INSTEK®

DC POWER SUPPLIES

20 MHz Scope	Cursor Readout	Triple Output	Single Output	Programmable	FUNCTION GENERATOR	BENCHTOP DMM
						
• **OS-620 $324.95** • Most economical scope • Dual CH/X-Y operation • 1 mV/div sensitivity • Z-axis input,CH1 output • TV syn, ALT trigger • 2 probes (x1, x10)	• **OS-626G $599.95** • **Readout & Cursor meas** • Dual CH / Delay sweep • Built-in delay line • ALT trigger, Hold-Off • Z-axis input,CH1 output • 2 probes (x1, x10)	• 2 variable out 0-30V,0-3A • One fixed 5V,3A output • Auto track, serial, parallel • Const. volt, current mode • 4 analog or 2 digital display **PC-3030** ($499.95) **PC-3030D** ($549.95) digital	• Const voltage, current mo • Voltage regulation ≤0.01% • Current regulation ≤0.2% **PS-1830** ($198.95) 18V/3A **PS-1850** ($214.95) 18V/5A **PS-1830D**($214.95)18V/3A **PS-1850D**($244.95)18V/5A	• Auto serial/parall.(PPT ser) • Auto track (PPT series), IEEE-488.2 and SCPI compatible command set **PPS-1860G**($1,149.95)18V/6A **PPS-3635G**($1,149.95)36V/3.5A **PPT-1830G**($1,499.95)18V/3A **PPT-3615G**($1,499.95)36V1.5A	**FG-8020G** ($209.95) • 0.02Hz-2MHz w/counter • Sine/Squ/Tri/pulse/Ramp **FG-8020G** ($209.95) • 0.02Hz-2MHz w/counter **FG-8050** ($449.95) Sweep • 0.05Hz-5MHz w/counter • INT/EXT AM/FM mod	**DM-8034**($179.95) 3½ dgt • AC/DV(V,A),C,Ω,diode **DM-8040**($339.95) 3¾ dgt • ACV to 50kHz, true rms **DM-8055G**($889.95)5½dgt • 0.006% accuracy, GPIB • dBm,auto,REL, min/max

ALFA ELECTRONICS
P.O. BOX 8089
PRINCETON, NJ 08543-8089

TEL: (800)526-2532 / (609) 897-1135
FAX: 609-897-0206
E-mail: sales@alfaelectronics.com

Call / Write / Fax / Email for FREE CATALOG
Visa, MC, AMEX, COD, PO Accepted. OEM Welcome.
1 Year Warranty (2 Years for GW/Instek)

CIRCLE 213 ON FREE INFORMATION CARD

RF Data Modules

AM Transmitter

- Sub Miniature module
- SAW Controlled
- No adjustable components
- Low current - 2.5mA
- Supply 2.5-12Vdc
- 418MHz or 433MHz
- Range up to 300ft
- CMOS/TTL data input
- 7 x 11 x 4mm !

AM-TX1-xxx $12.60

AM Receiver

- Compact Hybrid Module
- Very stable
- CMOS/TTL output
- Patented Laser Trimmed
- 5Vdc, 0.8mA (HRR6)
- 2kHz data rate
- Sensitivity -105dBm
- 38 x 12 x 2 mm

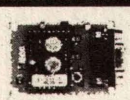
AM-HRR6-xxx... $16.33

FM Transceiver

- Only 23 x 33 x 11mm
- Up to 40,000bps data rate
- Up to 450ft. range.
- 5V operation
- 418MHz or 433MHz FM
- 5V CMOS logic interface
- Fast 1mS enable
- Power saving feature
- Carrier Detect output

BiM-xxx-F $87.36

RS232 Transceiver



- 3wire RS232 interface
- 19.2Kbps half duplex
- 418MHz or 433MHz FM
- 7.5-15Vdc, 20mA
- TX/RX Status LED's
- Up to 400ft. range
- 1/4 wave ant. on board
- User data packetizing
- 58 x 40 x 15mm

CYPHERNET $139.30

AM Transmitter

- Range up to 250ft.
- SAW controlled stability
- Wide supply range 2-14V
- CMOS/TTL input
- Low current. 4mA typ.
- Up to 4kHz data rate
- Small: 17 x 11mm

AM-RT5-xxx $12.10

ABACOM TECHNOLOGIES

Free Catalog

call: (416)236 3856
fax: (416)236 8866
www.abacom-tech.com
MasterCard / VISA

PCBoards

PCB Artwork Made Easy!

PRINTED CIRCUIT DESIGN SOFTWARE

For Windows and DOS

Layout - Autorouting - Schematic - Circuit Simulation

- 16 and 32 bit version available
- Ripup and Retry Router in Advanced Pkg.
- Copper Flooding for Building Ground Areas
- Gerber and Excellon Output
- Create Negative & Positive Printouts
- Create Single or Multi Layer Boards
- Create artwork from the Schematic
- Analog and Digital Simulation available
- Make boards up to 32" x 32"
- Parts Libraries - Silk Layers - Solder Mask
- **For the Professional and Hobbyist!**

Download DEMO - www.pcboards.net

Windows LAYOUT pgm. starts at $149

Windows Pkg. layout-schematic-router $399

DOS pcb layout - $49.95

Call or Write for Full Product Line, Prices & Free Demo

PCBoards
2110 14th Ave. South
Birmingham, AL 35205

(800)473-7227
Fax (205)933-2954
Phone (205)933-1122

www.web-tronics.com www.web-tronics.com www.web-tronics.com

Fantastic DMM Offer!

ONLY $19

Don't let this price fool you. This meter is a digital multimeter designed for engineers and hobbyists. Equipped with 5 functions and 19 ranges. Each test position is quickly and easily selected with a simple turn of the FUNCTION/ RANGE selector rotary switch. ***Rubber Boot Included!***

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C ±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery (NEDA 1604)
Low Battery Indication: BAT on Left of LCD Display
Dimensions: 188mm(L) x 87mm(W) x 33mm thick
Net Weight: 400g

#9300G

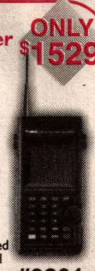
Get All the Specs From Our Web Site

2GHz RF Field Strength Analyzer

ONLY $1529

Protek

- Frequency Range: 100KHz to 2,060MHz
- Narrow Band FM (NFM), Wide Band FM (WFM), AM and Single Side Band (SSB) Modulated Signals May Be Measured
- PLL Tuning System for Precise Frequency Measurement and Tuning
- LED Backlight LCD (192x192 dots)
- Built-In Frequency Counter
- Hand-Held and Battery Operated
- All Functions are Menu Selected
- RS232C for PC Interface and Printer



#3201

See the web site for details

Removable Hard Drive Rack

For IDE/Ultra DMA Hard Drives

ONLY $14.95 any qty.

We Sold Over 14,000 in 1998!

This product can be used with any 3-1/2 IDE hard drive up to 1" high. It includes an electronic keylock for safe removal and insertion. Made of ABS 707 fireproof plastic. Use this product to protect sensitive hard drive data, take your hard drive between work and home or even set up different users with their own hard drives that they physically insert every time they use a PC. Other models available from C.S.I. include RH10 series and RH20 series, which are interchangeable within the same interface design (IDE or SCSI). ***Other Models are Available.*** *See www.web-tronics.com under "hard drive and accessories" for more details and pictures.*

#RH-10C-IDE

new! Removable Hard Drive Rack with Auto Door And Cooling Fan

ONLY $18.95 any qty.

- Auto door on the outer frame
- ABS material of outer frame. High efficiency cooling fan
- Worldwide patent pulling function handle
- CE Approved
- Coating iron bottom cover
- For IDE interface
- For 1" high 3.5" HDD
- Not compatible with our RH10 & RH20 series. Compatible with our RH17-IDE model.

#MR-27

Details at www.web-tronics.com

Auto-Temp Solder Station with Ceramic Element

ONLY $39

- With Ceramic Heating Element for More Accurate Temp Adjustment
- 3 Conductor Grounded Power Cord
- 250°C-480°C (470°F-900°F)
- Fast Heating Feature

SR-976

Extra Tip Options Available. See Web!

For More Info See www.web-tronics.com

CTRL - D to bookmark this site

www.web-tronics.com

Don't forget the dash

- Easy to Navigate
- Includes a Search Engine That Really Works
- New Items Added Constantly

Circuit Specialists Inc.

In Business Since 1971

CCD B&W Board Cameras

- *ASIC CCD Area Image Sensor*
- *Extremely Low Power Consumption*
- *0.5 Lux Min Illumination*
- *Built-In Electronic Auto Iris for Auto Light Compensation*

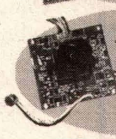
Detailed Specs on the Web

VMCB21 Infra-Red!
44mmx38.5mmx28mm with 6 infra-red LEDs, 12V
$49.00 any qty.

VM1030A
30mmx30mmx26mm Standard lens with audio, 12V
$49.00 any qty.

VM1030PA-B
30mmx30mmx25mm Pinhole lens with audio, 12V
$49.00 any qty.

VM1035A
42mmx42mmx25mm Standard lens with audio, 12V with back light compensation
$59.00 any qty.



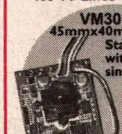
VM1036A
32mmx32mmx25mm Standard lens with audio, 12V, reverse mirror image feature
$59.00 any qty.

COLOR CCD Mini Board Cameras

- *Low Power Consumption*
- *1 Lux Illumination*
- *Built-In Electronic Auto Iris for Auto Light Compensation*
- *Internal Synchronization*
- *12Volts*
- *400 TV Lines*

VM3010PA
33mmx33mmx18mm Pinhole lens with audio
$129.00 any qty.

VM3011-A
45mmx40mmx24mm Standard lens with audio, single board
$99.00 any qty.



VM3010-A
33mmx33mmx32mm Standard lens with audio
$129.00 any qty.

Detailed Specs on the Web

Bullet CCD Cameras B&W and Color

- *Smart Rugged Metal Housing*
- *Extremely Low Power Consumption*
- *12 Volt*
- *CCD Area Image Sensor for Long Camera Life*
- *Built-In Electronic Auto Iris for Auto Light Compensation*
- *No Blooming, No Burning*
- *0.1 Min Lux Illumination (B&W), 1 Lux Min Lux Illumination (color)*

VMBLT3025W
Digital Color, Weatherproof 20mm(D)x83mm(L)
$189.00 any qty.

VMBLT1020W
B&W Weatherproof 21mm(D)x58.5mm(L)
$79.00 any qty.

VMBLT1020A
B&W with audio 21mm(D)x55mm(L)
$69.00 any qty.

Detailed Specs on the Web

Protek Amazing Oscilloscope Offers

Series 6500 Deluxe 20MHz/40MHz/60MHz/100MHz Dual-Trace Oscilloscopes

- *Alternate Trigger*
- *Internal Sync Seperator Circuit*
- *Alt-Mag Sweep*
- *Delay Sweep (6510)*

LATEST DESIGNS!

Asia's currencies are devalued against U.S. dollars Take advantage of GREAT prices while they last!

#6504 - 40MHz $569

#6510 - 100MHz $799

#6502 - 20MHz $289

#6506 - 60MHz $689

For More Information See www.web-tronics.com

These deluxe HC Protek oscilloscopes provide the features and accuracy that serious technicians and engineers need at prices well below what you may have expected. These dual-trace, dual-channel, scopes have Alt-Mag sweeps and provide simultaneous display of normal and magnified traces. An internal sync seperator circuit provides stable triggering of video signals. TV-H (TV line synchronizing feature) and TV-V (TV frame synchronizing frequency) are automatically switched by the Time/Div front-panel control. The user can view parallax-free waveform measurements on the large 6" rectangular CRT that includes an illuminated internal 8x10 Div graticule.

Part No.	6510	6506	6504	6502
Bandwidth	100MHz	60MHz	40MHz	20MHz
Vert. Sensitivity	1mV/DIV to 5V/Div	1mV/Div to 5V/Div	1mV/Div to 5V/Div	1mV/Div to 5V/Div
Max Sweep Rate	2nS/Div to 0.2S/Div	0.1μS/Div to 0.2S/Div	0.1μS/Div to 0.2S/Div	0.2μS/Div to 0.5S/Div
Delay Sweep	YES	ALT-MAG	ALT-MAG	ALT-MAG
Vert. Mode Trig.	YES	YES	YES	YES
Cursor Readout	NO	NO	NO	NO
CRT Volts	12KV	10KV	10KV	2KV

new! Mini CCDs (B/W & Color)

Sensational NEW Design for Small Observation Cameras. *Smaller and Better!*

- *Ultra Miniature Design*
- *Black & White Versions Only 25mm x 25mm*
- *Color Versions Only 32mm x 32mm*
- *Available in Standard Lens or Pinhole Lens*
- *All Include Audio*
- *All Include Pre-Wired Cable Harness for Audio, Video & Power*
- *12V Regulated Power Supply Required (120mA typical power consumption)*
- *0.1 LUX Rating (B/W), 1 LUX (color)*
- *CCD Area Image Sensor for Long Camera Life*
- *Back Light Compensation Circuit*
- *Built-In Electronic Auto Iris Lens*

VMCW-H11A
32mmx32mmx30mm, Color CCD with standard lens, pre-wired cabling for video/audio, 12V DC Power
$149.00 $139.00 5 or more

VMCW-H12A
32mmx32mmx19mm, Color CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input
$149.00 $139.00 5 or more

Detailed Specs on the Web

VMPS-718A
25mmx25mmx30mm, B/W CCD with standard lens, pre-wired cabling for video/audio, 12V DC Power Input
$69.00 $59.00 5 or more

VMPS-250A
25mmx25mmx15mm, B/W CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input
$69.00 $59.00 5 or more

new! 3000 Series Digital R/O Bench Power Supplies

←Low Cost Single Output ←High Performance Triple Output

AS LOW AS $89

High stability digital read-out bench power supplies featuring constant voltage and current outputs. Short-circuit protection and current limiting protection is provided. The dual output versions can be used in both serial voltage and parallel current configurations to double maximum outputs.

Highly accurate LED accuracy and stable line regulation make the 3000 series the perfect choice for lab and educational use.

Line Regulation: $2x10^{-4}$ +1ma
LED Accuracy: Voltage ±1% +2 digits
Current ±1.5% +2 digits
Wave Line Noise: ≤1mvrms
Dimensions: 291mm x 158mm x 136mm (CSI3003 & CSI3010)
365mm x 265mm x 164mm (CSI3003-3 & 3005-53)

CSI3003: 0-30v/0-3amp Digital R/O Bench PS, $1x10^{-4}$+5mv Load Regulation $99.00 5/$89.00
CSI3010: 0-30v/0-10amp Digital R/O Bench PS, $1x10^{-4}$+30mv Load Regulation $149.00 5/$139.00
CSI3003-3: Triple Output 2x(0-30v/0-3amp)+5v, 3amp Fixed, $1x10^{-4}$+5mv Load Regulation $239.00 5/$219.00
CSI3005-3: Triple Output, 2x(0-30v/0-5amp) +5v, 3amp Fixed, $1x10^{-4}$+25mv Load Regulation $269.00 5/$249.00

3000 Series Supplies Will Become Available Approximately September 15, 1999. Orders Are Being Taken Now.

Our Most Sophisticated DMM

We Sold Over 700 Last Year!

NOW ONLY $129 *Reg. $169*

with RS-232 Interface & Software, 3-3/4 Digit, 4000 Count, Auto-Ranging with Analog Bargraph

- True RMS Mode
- 10MHz Frequency Counter
- Time Mode with Alarm, Clock, and Stop Watch
- Dual Display
- 10 Location Memory
- Min, Max, Avg and Relative Mode
- Decibel Measurement
- Cap and Ind. Measurement
- Temperature Mode (C/F)
- K Type Temperature Probe Included
- Pulse Signal for Logic & Audible Test
- Continuity/Diode Test
- Logic Test
- Auto Power OFF/"Keep ON" Mode
- Fused 20A Input with Warning Beeper
- Back Light
- Data Hold/Run Mode
- Safety Design UL1244 & VDE-0411
- Protective Holster
- Silicon Test Leads

More Details on our Web Site

PROTEK 506

CIRCUIT SPECIALISTS, INC. *220 S. Country Club Dr., Mesa, AZ 85210 800-528-1417/480-464-2485/FAX: 480-464-5824*

CIRCLE 332 ON FREE INFORMATION CARD

SUPERCIRCUITS

America's #1 Microvideo Source

AMAZING!

MICRO VIDEO TOP 10

OVER 120 NEW VIDEO PRODUCTS!

1. World's Smallest Video Camera* .....1 lux, .3oz. $59.95
2. Pinhole Video Camera..410 lines, 0.5 lux, Sharp chip $39.95
3. Color Video Camera....350 lines, 2 lux, Remote head $69.95
4. Live R/C Aerial Videotape.....How to's and more $24.95
5. Wireless Covert Tape Cam.....300' range, FCC OK $349.95
6. Super Tiny Color Pinhole Cam....350 lines, 1" sq. $99.95
7. Micro Video Transmitter.....1000' rnage, ATV band $159.95
8. Complete Wireless ATV Video Set . 3 miles range $419.95
9. World's Smallest Wireless Video Cam.....Please Call
10. Video Goggles.....Dual hi-res LCD's, 3D capable $599.95

If you're looking for the best in microvideo...
Call us today and get our new 72 page catalog!

1-800-335-9777 ext ES

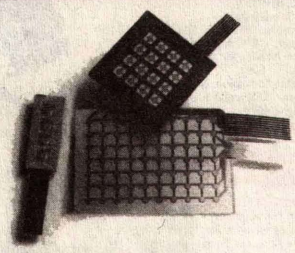
Or fax us at 512-260-0444

www.supercircuits.com

Used on NASA Space Flight*

* See video from Supercircuits PC-67XS spacecam on our web site...also live R/C plane aerials!

MEMBRANE SWITCHES



Stock Layouts!

Eliminates tooling cost...

****From 2 to 128 keys****

Industrial/Commercial/ Prototyping

Popular types are available as complete *kits*, with bezel, connector & overlay!

4 key DSK-4 **kit** ***$9.60***
12 key DSK-12 **kit** ***$13.87***
many more layouts...

Optional Stainless Steel "Clickdomes".

Sil-Walker
(805) 491-0654
FAX (805) 491-2212
P.O. Box 3220
Camarillo, CA 93011-3220
silwkr@vcnet.com
www.vcnet.com/silwkr/

MASTERCARD/VISA

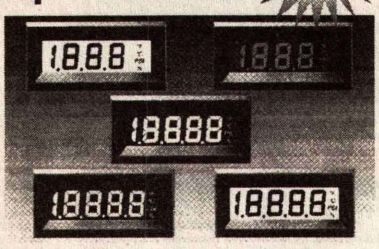
Introducing...

The **Epic Series**

NEW

280 different configurations in a single size, snap-in mounted case

Create a look of conformity on panels



Choose from:
- 3 1/2 or 4 1/2 digit displays
- voltage or process loop inputs
- black, red, amber or green numerals
- black numerals with lighted green background

Features:
- selectable, displayed engineering units
- resistant to RF and EMI
- economically priced
- five year warranty

KNS Instruments

Visit our catalog on the web: www.knsinstruments.com

800-356-4920

PO Box 10158
Bedford, NH 03110-0158
Fax 800-356-1250

Brand Electronics
Digital Power Meters

Measures and displays:
Real Power: 1 to 1850 w;
Vrms, Irms, VAR, VA
PF, Peak Watts, kwhrs,
cost per month.
Features available:
computer interfacing,
data logging.
Models from $149.95
Custom applications
orders: 1-800-433-6600
info: 207-549-3401
www.brandelectronics.com
dealer inquiries:
atkinson@brandelectronics.com

EZ-EP DEVICE PROGRAMMER - $169.95

Check Web!! -- *www.m2l.com*

Fast - Programs 27C010 in 23 seconds
Portable - Connects to PC Parallel Port
Versatile - Programs 2716-080 plus EE and Flash (28F,29C) to 32 pins
Inexpensive - Best for less than $200

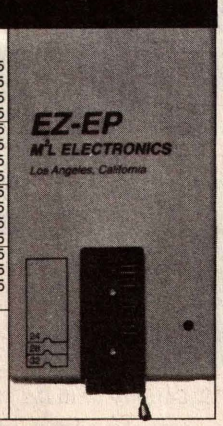
- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters

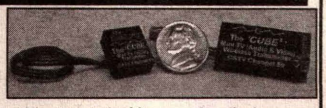
EP-PIC (16C5x,61,62x,71,84)	$49.95
EP-PIC64 (62-5,72-4)	$39.95
EP-PIC12 (12C50x)	$39.95
EP-PIC17 (17C4x)	$49.95
EP-51(8751,C51)	$39.95
EP-11E (68HC11 E/A)	$59.95
EP-11D (68HC711D3)	$39.95
EP-16 (16bit 40pin EPROMS)	$49.95
EP-Z8(Z86E02,3,4,6,7,8)	$39.95
EP-SEE2 (93x,24x,25x,85x)	$39.95
EP-750 (87C750,1,2)	$59.95
EP-PEEL (ICT22v10,18v8)	$59.95
EP-1051(89C1051,2051)	$39.95
EP-PLCC (PLCC EPROMs)	$49.95
EP-SOIC (SOIC EPROMs)	$49.95

Many Other Adapters Available

M²L Electronics
970/259-0555 Fax: 970/259-0777
250 CR 218 Durango, CO 81301
CO orders add 7% sales tax.
http://www.m2l.com

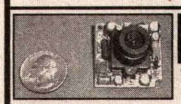


World's Smallest TV Transmitters



We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies- that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

C-2000, Basic Video Transmitter Cube..... $89.95
C-3000, Basic Video & Audio Transmitter Cube..... $149.95
C-2001, High Power Video Transmitter Cube..... $179.95
C-3001, High Power Video & Audio Transmitter Cube... $229.95



CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infra-Red) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSP! Available with Wide-angle (80º) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for audio sound pick-up and super easy direct wire hook-up to any Video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens..... $69.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens..... $69.95
CCDCC-1, Color CCD Camera, wide-angle lens..... $129.95
IR-1, IR Illuminator Kit for B&W cameras..... $24.95
IB-1, Interface Board Kit..... $14.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

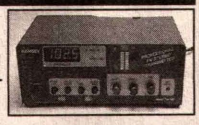
AR-1, Airband 108-136 MHz Kit $29.95
HFRC-1, WWV 10 MHz (crystal controlled) Kit $34.95
FR-1, FM Broadcast Band 88-108 MHz Kit..... $24.95
FR-6, 6 Meter FM Ham Band Kit..... $34.95
FR-10, 10 Meter FM Ham Band Kit..... $34.95
FR-146, 2 Meter FM Ham Band Kit..... $34.95
FR-220, 220 MHz FM Ham Band Kit $34.95
SR-1, Shortwave 4-11 MHz Band Kit $29.95
Matching Case Set (specify for which kit)..... $14.95

Tiny FM Transmitters

Gosh, these babies are tiny - that's a quarter in the picture! Choose the unit that's best for you. FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny included watch battery, uses SMT parts. FM-4 is larger, more powerful, runs on 5-12 volts, goes up to a mile. FM4,5 operate in standard FM band 88-108 MHz. FM-6 is crystal controlled in 2 meter ham band, 146.535 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & loose a part!

FM-4MC, High Power FM Transmitter Kit..... $17.95
FM-5, World's Smallest FM Transmitter Kit $19.95
FM-6, Crystal Controlled 2M FM Transmitter Kit..... $39.95
FM-6, Fully Wired & Tested 2M FM Transmitter $69.95

Super Pro FM Stereo Transmitter



Professional synthesized FM Stereo station in easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. *We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.*

FM-100, Pro FM Stereo Transmitter Kit..... $249.95
FM-100WT, Fully Wired High Power FM-100...., $399.95

FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized FM Stereo Transmitter Kit $129.95

Lower cost alternative to our high performance transmitters. Great value, tunable over FM band, plenty of power and manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice 'pro' look.

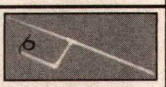
FM-10A, Tunable FM Stereo Transmitter Kit $34.95
CFM, Matching Case and Antenna Set $14.95
FMAC, 12 Volt DC Wall Plug Adapter..... $9.95

RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set.

LPA-1, Power Booster Amplifier Kit..... $39.95
CLPA, Matching Case Set for LPA-1 Kit $14.95
LPA-1WT, Fully Wired LPA-1 with Case..... $99.95

FM Station Broadcast Antenna



For maximum performance, a good antenna is needed. Properly tuned and matched antenna is fully PVC enclosed for weather protection and rugged use. Vertical or horizontal mounting, 'F' style connector, 5' long.

TM-100, Tru-Match FM Station Antenna Kit.....$39.95

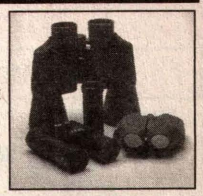
AM Radio Transmitter

Operates in standard AM broadcast band, set to clear channel in your area. AM-25 'pro' version is synthesized for stable, no-drift frequency and is setable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 has tunable transmit oscillator, runs FCC maximum 100 mw power, expected range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set for a finished, professional look. High level modulation for low distortion.

AM-25, Professional AM Transmitter Kit..... $129.95
AM-1, Entry level AM Radio Transmitter Kit $29.95
CAM, Matching Case Set for AM-1..... $14.95

RAMSEY

Binocular Special



Wow, did we nab a deal on these first rate binoculars! Absolutely identical to a famous big name brand here in Rochester, NY - but without 'their' name. Well made with fully coated optics, super nice rubber armored housing over hi-alloy aluminum, includes lens cleaner cloth, neck lanyard and carry case. 4 styles: roof prism 10x25 (10 power, 25 mm), 10x25 high performance roof prism ruby coated objective lens model for demanding use in bright sun, 10x25 high-end BAK-4 lens porro prism ruby coat with TacGrip housing, and Ultra-View 10x50 porro prism ruby coats. First quality, yet at a close-out price on the exact same units as the 'Trademarked' units - but at half price!

BNO-M, 8x21 Mini Monocular $14.95
BNO-1, 10x25 Roof Prism Binoculars..... $24.95
BNO-1EX, 10x25 Ruby Coated Porro Prism $29.95
BNO-2, 10x25 TacGrip Ruby Coat Porro Prism..... $59.95
BNO-6, 10x50 Ultra-View Ruby Coat Porro Prism... $69.95

World's Smallest FM Radios

Everyone who sees one of these babies says they just gotta have one! Super cute tiny FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. You will be amazed at the crystal clear amazing sound! That's a quarter in the picture for size comparison - pretty tiny, huh?

MFMT-1, World's Smallest FM Radio..... $11.95
PFMR-1, Pager Style LCD Clock & FM Radio $12.95

Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems, hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.

SS-70A, Speech Descrambler/Scrambler Kit..... $39.95
CSS, Custom Matching Case and Knob Set $14.95
SS-70AWT, Fully Wired SS-70A with Case..... $79.95
AC12-5, 12 Volt DC Wall Plug Adapter..... $9.95

Call for our Free Catalog !

See our complete catalog and order on-line with our secure server at:

www.ramseyelectronics.com

RAMSEY ELECTRONICS, INC.
793 Canning Parkway Victor, NY 14564

Order Toll-free: 800-446-2295

Sorry, no tech info, or order status at this number

For Technical Info, Order Status Call Factory direct: 716-924-4560

VISA MasterCard AMERICAN EXPRESS DISCOVER

ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add $6.95 for shipping, handling and insurance. Orders under $20, add $3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

CALL TOLL FREE
(800) 292-7711
Orders Only
Se Habla Español

C&S Sales

Look For Other Monthly Specials On Our Website

Excellence in Service

www.cs-sales.com

Power Supplies

Elenco Quad Power Supply
Model XP-581

$79.95

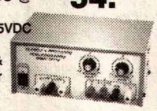
4 Fully Regulated DC Power Supplies in One Unit

4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

Elenco Power Supply Kit
Model XP-720K

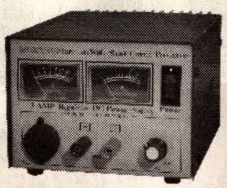
$54.95

- 1.5VDC - 15VDC @ 1A
- --1.5VDC - --15VDC
- 5VDC @ 3A
- 6.3VAC @ 1A & 12.6VAC center tapped @1A



XP-720 Fully Assembled $85

Elenco DC Power Supply
Model SPL-603 $79.95
3A 0-30VDC



The SPL-603 is a solid-state DC power supply providing the exact output voltage no matter what current you use. It contains one fully regulated power supply. The variable voltage is capable of delivering 0-30V at up to 3A. The output is precisely held to the desired output voltage by a special regulating circuit. Output fully protected from overload.

Miscellaneous

Elenco Model EP-50

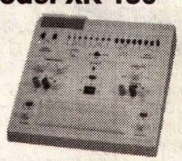
Electronic Playground and Learning Center Contains Over 50 Experiments

$19.95

Elenco Model XK-150

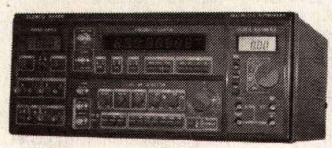
Digital/Analog Trainer

$89.95



Ideal for Schools

Elenco Model MX-9300
Four Functions in One



$450

Features:

- One instrument with four test and measuring systems:
  - 1.3GHz Frequency Counter
  - 2MHz Sweep Function Generator
  - Digital Multimeter
  - Digital Triple Power Supply - 0-30V @ 3A, 15V @ 1A, 5V @2A

Generators & Counters

Elenco Sweep Function Generator
w/ built-in frequency counter **Model GF-8036**

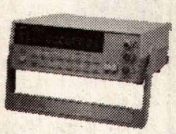
$225

This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

10 Function 1.3GHz Universal Counter
Elenco Model F-1300

- Frequency .05Hz - 1.3GHz 3 Ranges
- Period - Can read 60Hz to 60.000000 F=1/T
- Totalize - Counts to 199,999,999
- RPM - 3 to 2099994 RPM
- Duty Cycle
- Max/Min/AVG with Time
- Stop-watch set .2 sec. to 100 hrs.
- Math Functions
- Timer - 2 sec. to 99 days
- Pulse Width - 0.1ms to 66666.6ms

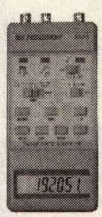
$225



Multifunction Counter

B&K Model

$189



1875
10Hz - 2.5GHz
Ultra sensitive synchronous detector bar-graph and RF strength.
3 Channels

Measures Frequency, Period, Data Hold, Relative, Memory (min., max., average). High Sensitivity, Microprocessor Controlled.

Elenco Handheld Universal Counter
10Hz - 2.8GHz
Model F-2800

$99

Features 10 digit display, 16 segment and RF signal strength bargraph.

Includes antenna, NiCad battery, and AC adapter.

Elenco RF Generator with Counter
(100kHz - 150kHz) **Model SG-9500**

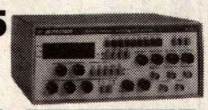
Features internal AM mod. of 1kHz, RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS. $225

SG-9000 ..... $119.95
(analog, w/o counter)

B&K 20MHz Sweep/Function Generator with Frequency Counter **Model 4040**

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

$445



10MHz Model 4017 $319
5MHz Model 4011 $249

BK PRECISION

Kit Corner

over 100 kits available

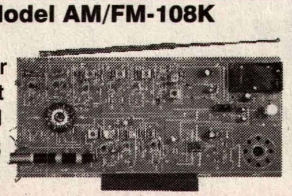
Model AK-870
Radio Control Car Kit

$24.95

- **Solderless**
- 7 Functions
- Radio Control Transmitter Included

Model AM/FM-108K
AM/FM Transistor Radio Kit w/ Stand

$29.95



Model AK-700
Pulse/Tone Telephone Kit

Ideal School Project

$15.95

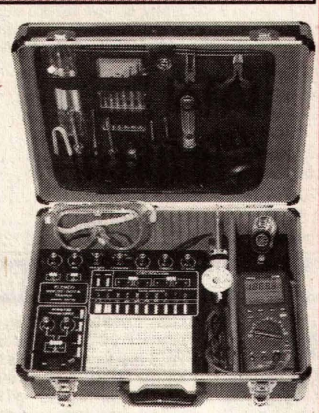
Elenco Digital / Analog Trainer

Model XK-700

Elenco's newest advanced Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator w/ continuously sine, triangular and square waveforms, 1,560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

XK-700
Assembled & Tested
$189.95

XK-700K - Kit
$159.95



Made in USA

Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710

15 DAY MONEY BACK GUARANTEE
2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 322 ON FREE INFORMATION CARD

SAME DAY SHIPPING C&S Sales

Excellence in Service

CALL OR WRITE FOR OUR FREE 64 PAGE CATALOG! (800) 445-3201

Digital Multimeters

Elenco LCR & DMM Model LCM-1950

12 Functions
Freq. to 4MHz
Inductance
Capacitance
and Much More

$69

Elenco Model M-1740

$39.95

11 Functions:
- Freq. to 20MHz
- Cap. to 20µF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-1244 safety specs.

Model M-2760 - $24.95 (9 functions)

Fluke 79III

$185

- Capacitance ranges from 99.99nF to 9999µF.
- Built-in frequency counter of voltage input from 1Hz to over 20kHz.
- Lo-Ohms range, a 40Ω range with Fluke's proprietary Zero Calibration, offers 0.01 resolution with increased noise rejection.

Series II (limited qty.) **$179**

Fluke 87III

$299

Features high performance AC/DC voltage and current measurement, frequency, duty cycle, resistance, conductance, and capacitance measurement.

Series II (limited qty.) **$289**

Elenco Model LCR-1810

$99.95

- Capacitance .1pF to 20µF
- Inductance 1µH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

Elenco Model M-1005K

$14.95 Digital Multimeter Kit

- 18 Ranges
- 3 1/2 Digit LCD
- Transistor Test
- Diode Test

M-1000B (Assembled)..... **$14.95**

Dual-Display LCR Meter w/ Stat Functions

B&K Model 878

$219.95

Auto/manual range

Many features with Q factor

High Accuracy

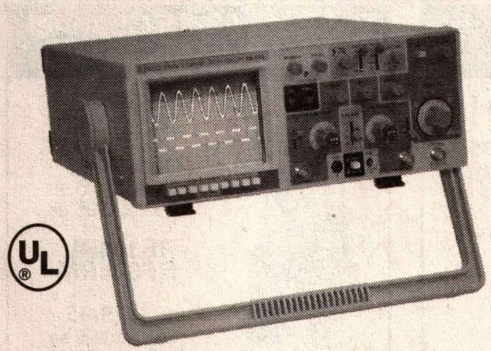
Elenco Model 6100

$99.95

- True RMS of high speed signals
- Computer interface and software
- Frequency to 200KHz
- Capacitance to 40µF
- Large 3 3/4 LCD display
- Captures and displays max, min, & avg.
- Relative % to reference
- Three hold system
- Analog bar graph and pointer
- Audible continuity
- Auto power off
- Unit indicator
- Diode test

Oscilloscopes

Free Dust Cover and 2 Probes



S-1325	25MHz	Dual Trace	$325
S-1330	25MHz	Delayed Sweep	$439
S-1340	40MHz	Dual Trace	$475
S-1345	40MHz	Delayed Sweep	$569
S-1360	60MHz	Delayed Sweep	$749
S-1390	100MHz	Delayed Sweep	$995

DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s Analog/Digital	$695
DS-303	40MHz/20Ms/s Analog/Digital	$995
DS-603	60MHz/20Ms/s Analog/Digital	$1295

TEKK Radios

Both Models Available in Yellow, Blue & Black

Pro-Sport FRS Two-Way Radio Model PRO-SPORT+

Talk up to 2 miles!

Model PRO-SPORT
- 1/2 Watt Output, 14 Channels.
- TX LED Indicator.
- Removable Belt Clip.
- Highly Water Resistant.
- Economy Type
- No License Required!

$68.00 each or 2 for $109.95

No License Required

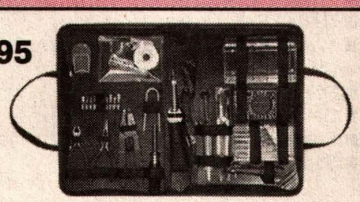
Model PRO-SPORT +
- 1/2 Watt Output, 14 Channels.
- TX & RX LED/LCD Indicators.
- Large LCD Display.
- 38 Privacy (CTCSS) Tones.
- Plus All Features of Pro-Sport Model.

$79.00 each or 2 for $149.95

Elenco Technician Tool Kit

Model TK-1500 **$49.95**

28 tools plus a DMM (M-1000B) contained in a large flexible tool case with a handle ideal for everyone on the go.



Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

SEE US ON THE WEB → www.cs-sales.com

C&S SALES, INC.

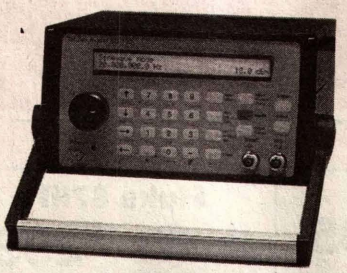
150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710

15 DAY MONEY BACK GUARANTEE
2 YEAR FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 322 ON FREE INFORMATION CARD

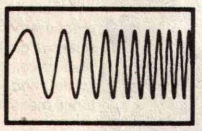
Any waveform you want!

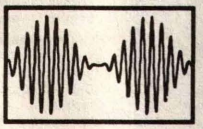


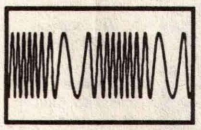
New Features:
- ✔ 21.5 MHz
- ✔ .01 Hz steps
- ✔ multi-unit phaselock

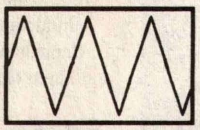
Telulex Inc. model SG-100A

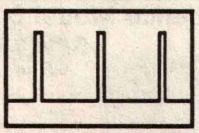
- **Synthesized Signal Generator**
  Clean sinewaves DC-21.5 MHz, .001% accuracy! .01 Hz steps. DC Offset. RS232 remote control.
- **Arbitrary Waveform Generator**
  40 Megasamples/Second. 32,768 points. 12 bit DAC
- **Function Generator**
  Ramps, Triangles, Exponentials & more to 2 MHz!
- **Pulse Generator**
  Digital waveforms with adjustable duty cycle

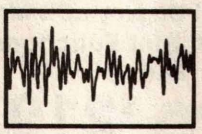

DC to 21.5 MHz linear and log sweeps

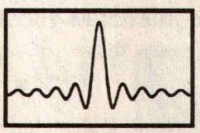

Int/Ext AM, SSB, Dualtone Gen.

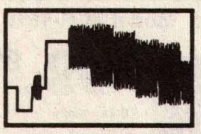

Int/Ext FM, PM, BPSK, Burst


Ramps, Triangles, Exponentials


Pulse Generator


Noise


Arbitrary Waveforms

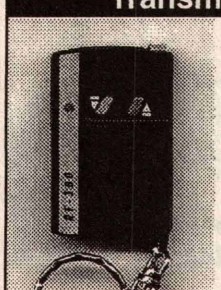

Unlimited Possibilities!

Telulex Inc.
2455 Old Middlefield Way S, Mountain View, CA 94043
Tel (650) 938-0240 **Fax** (650) 938-0241
http://www.Telulex.com Email: sales@Telulex.com

CIRCLE 312 ON FREE INFORMATION CARD

Miniature Transmitters and Receivers

2 Button / 3 Channel Transmitter

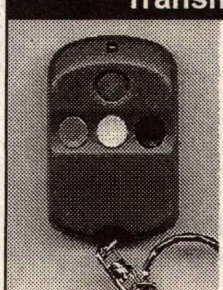


RF300T
1....$22.95
5.....$19.95 ea
10...$16.95 ea

RF300XT
1....$25.95
5.....$22.95 ea
10...$19.95 ea

- 300' (XT), 150' (T) Range
- Frequency: 318 MHz
- 59,049 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.8 ma
- Fully Assembled in Case
- Dimensions: 1.25" x 2.0" x .5"
- Push both buttons for the 3rd Channel
- Slide Button Cover Included

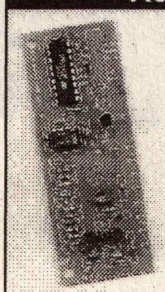
4 Button / 15 Channel Transmitter



RF304XT
1....$27.95
5.....$24.95 ea
10...$21.95 ea

- 250' Range
- Frequency: 318 MHz
- 6,561 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.6 ma
- Fully Assembled in Case
- Dimensions: 1.35" x 2.25" x .5"
- Push combination of buttons to achieve up to 15 channels

2-4 Data / 3-15 Channel Receivers



RF300RL
RF300RM
1....$27.95
5.....$24.95 ea
10...$22.95 ea

RF304RL
RF304RM
1....$29.95
5.....$26.95 ea
10...$23.95 ea

- Compatible with 300/4 Transmitters
- 11-24 volts DC Operating Voltage
- 13 ma. Current Draw
- Latching (L) or Momentary (M) Output
- Kits Available (subtract $5.00 ea.)
- Dimensions: 1.25" x 3.75" x .5"
- 2 (300) / 4 (304) Output Data Lines
- Binary to Dec / Hex Converter can achieve up to 15 channels

- Alarm Systems
- Garage / Gate Openers
- Lighting Control
- Magic Props
- Medical Alert
- Monitoring Systems
- Industrial Controls
- Surveillance Control
- Motor Control
- Schematics Available
- Receiver Board Layout Available
- Custom Design Consulting Available

Visitect Inc.
(510) 651-1425 Fax: (510) 651-8454 Email: Support@Visitect.Com
P.O. Box 14156, Fremont, CA 94539 Visa / Mastercard, COD

CIRCLE 310 ON FREE INFORMATION CARD

ARE YOU BEING "BUGGED?"

EVEN AS YOU READ THIS, countless individuals and firms are being enormously damaged by having their private conversations overheard, monitored, and\or recorded.
Almost without exception and AFTER the fact, the victims make a statement something along the lines of "But, I never thought it could happen to ME!

OUR FINEST

Counter-Surveillance Device

THE ULTIMATE IN "BUG" DETECTION EQUIPMENT "DEBUGS" ROOMS AND TELEPHONES!

If you require GUARANTEED PROTECTION against electronic telephone monitoring devices and COMPLETE CONFIDENTIAL PRIVACY in certain rooms and areas, we highly recommend the COUNTER-SURVEILLANCE DETECTOR CSD-18.

CONDUCT A PROFESSIONAL SEARCH...ANYTIME...ANYWHERE!

Every newspaper and magazine article and every radio and TV story discussing some new episode involving "Bugging" devices, continues to increase the ever growing demand for electronic Counter-Surveillance "sweeps" and equipment. The very limited supply of competently trained and equipped Counter-Surveillance specialists has created a situation where "sweep" rates exceeding $250 per hour are now considered reasonable and appropriate.

This is an exciting, immensely interesting and profitable field that you can enter with a minimum investment. Two hours actual practice with the CSD-18 will have you "reading" and "clearing" telephones and rooms with professional ease and competence. The average fee for "debugging" a single telephone is over $200.00 It requires about 45 minutes to complete the job and once it gets around that YOU can provide this service, you'll quickly have more clients than you can handle.
Even if you choose to provide "sweeps" for only a small number of friends and associates, your initial investment will quickly be returned many times over.

EXTREME SENSITIVITY!

This is our finest piece of detection equipment! The CSD-18 quickly locates electronic eavesdropping devices in telephones, homes, offices, vehicles, boats, or concealed on the body. It will actually pick up many eavesdropping transmitters at ranges up to 25 ft! Extreme sensitivity is obtained via ultra-efficient amplification circuitry directly following the RF detection stages. Excellent quality dynamic headphones exclude all external sounds to further enhance detector output.

Encompassing an extremely wide-band frequency coverage of under 1 Mhz to over 3 Ghz, the CSD-18 quickly "homes-in" on any eavesdropping transmitter and immediately pinpoints its location. The closer you get to the "bug", the further the needle moves to the right. It's as simple as that.

FULL RANGE DYNAMIC HEADPHONES

"FLASHING" LED WARNS YOU INSTANTLY!

And, for maximum telephone security, the CSD-18 automatically analyzes a pre-programmed series of electronic measurements along the telephone line and converts the analysis into an easy to follow, step by step, test procedure. No technical knowledge is required or necessary. A visual indication (via a flashing LED) immediately reveals the presence of the various types of telephone "taps" and the flashing sequence identifies the actual type of eavesdropping device.

DETECTS THE LATEST "SUPER-BUGS"

Exclusive GSS proprietary circuitry assures the utmost privacy protection possible today. The CSD-18 detects even the very latest ultra-sophisticated eavesdropping devices specifically designed to defeat detection, including sophisticated "Frequency Hoppers" and "Burst Bugs". Also includes multi-line option for testing business phones.

FREE WITH ORDER!

SUBMINIATURE "BODY WIRE" DETECTOR!

If you fear the possibility of being overheard and/or recorded during private conversations and require "silent" notification, we've also included our SBD-5 (regularly $225) as a FREE GIFT! Only 3" x 2" x 1", this exciting new development in micro-miniaturization will instantly detect hidden body wires at ranges up to 10 ft and alert you via a silent vibration.

BIG MONEY OPPORTUNITIES!

Also, complete information describing the fantastic opportunities now open to trained Counter-Surveillance technicians and how a number of individuals are reaping a Bonanza in this booming business! You'll learn exactly how the ever increasing use of Electronic Listening Devices by investigative agencies, government agencies, jealous suitors and unscrupulous business competitors, etc. has created huge demand for this service.

FASCINATING HI-TECH INFORMATION PACKAGE!

A detailed analysis of a variety of extremely fascinating hi-tech devices and procedures used for ultra-sophisticated audio and video eavesdropping including micro-wave and laser device monitoring; new methods for listening thru walls; all about scramblers, voice changers and exactly how neighbors eavesdrop. How missing persons are found, confidential data banks are broken into, lie detectors deceived and much more!

A comprehensive information package JAM-PACKED FULL of some of the most exciting and fascinating reading imaginable. Reads like a James Bond novel, with one important exception...IT'S NOT FICTION!

THE ONE "BUG" TO FEAR MOST!

While most individuals are now somewhat guarded in their telephone conversations, they still rather naively feel secure in the "privacy" of their own home or office. However, the most common type of "tap" presently used by eavesdroppers now picks up ALL SOUNDS AND CONVERSATION WITHIN A ROOM ... **WITH THE TELEPHONE STILL ON THE HOOK!**

Due to this devastating capability, this "Infinity" tap (variously referred to as Infinity Transmitter, Hookswitch Bypass, 3rd Wire, Harmonica Bug, etc.) has become the "bug of choice".

In flagrant violation of federal law prohibiting their use and sale, these devices in various forms are openly advertised in many technical publications for as little as $30. Literally thousands of these devices are now in the hands of unscrupulous individuals all over the country!

In response to this ever-growing threat, a uniquely engineered feature of the CSD-18 now also detects Infinity type devices anywhere "down the line".

In other words, if ANYONE ... ANYWHERE ... is utilizing the telephone tip and/or ring wires to monitor your private room conversations while your telephone is on the hook, you'll immediately be made aware of it via a flashing LED!

100% POSITIVE INDICATION

The CSD-18 also flawlessly detects "Series" and "Parallel" telephone transmitters and "Telephone Recording Devices". And, a separate feature silently indicates when extension phones are picked up or being used. The CSD-18 completely eliminates all doubt and guesswork.

EXCLUSIVE "LISTEN-IN" FEATURE!

The CSD-18 will even allow you to "listen-in" to exactly what the eavesdropper is surreptitiously monitoring. And, without the eavesdropper ever becoming aware that he has been detected! We are unaware of ANY other detection equipment having this combined capability AT ANY PRICE!

MAXIMUM PROTECTION

The CSD-18 detects and locates ALL major categories of surveillance equipment including:
BUMPER BEEPERS,
"BODY" TRANSMITTERS
TELEPHONE RECORDING DEVICES
SERIES & PARALLEL PHONE TRANSMITTERS
"INFINITY", MICRO-WAVE AND "LASER" BUGS
& ALL TYPES OF CONCEALED TRANSMITTERS
including Video, Computer and Fax Transmitters

CSD-18 **$495** Complete

Includes headphones, antenna/probe, all plugs and adapters, batteries, the Free SBD-5 & Info Packages.

HOW TO ORDER

Order NOW by Mail or Telephone. 10 DAY MONEY BACK GUARANTEE if you're not 100% pleased and completely satisfied. We pay shipping charges on all prepaid & credit card orders. Add $15 for CODs.

(C) 1995 **Great Southern Security**
513 Bankhead Highway
Carrollton, GA 30117

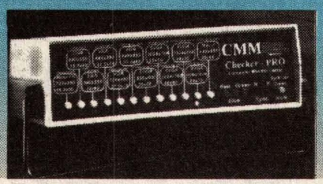
FOR FASTEST SERVICE CALL TOLL FREE

ORDER BY PHONE **1 800 732-5000**

VISA MasterCard DISCOVER

CMM
Monitor/TV Test Equipment

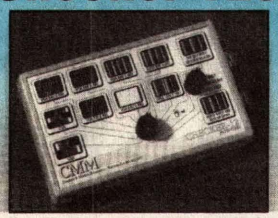
Checker Pro



There is the Computer monitor tester you have been asking for. Sweep rates to 15-64 kHz, MGA, CGA, VGA, lots of MACs, even video (mono), GRAY SCALE, quick push button operation, "Energy Star" testing, and more. AC or Battery.

PRICE: $499.95

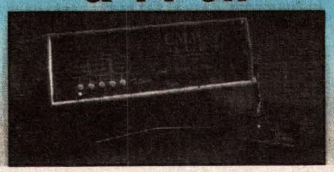
Checker 12e



Now you can repair and test Computer monitors with ease. With sweep rates up to 64Khz., eight step gray scale, white screen, single color mode. Mac II, EGA, CGA support, you can run almost ANY PC monitor. And it is EASY to use. Color front panel displays show just what you should see. Don't let its' small size fool you. It is the most powerful handheld available, and it supports ALL basic VGA modes (some don't). It is suitable for bench or field operations. Battery or AC operation.

PRICE:$295

Checker TV Pro & TV Jr.



The TV Pro is just the tool for your repair bench. It provides Video, S-Video, and RF outputs. It also has the most important pattern, GRAY SCALE! You can't set up a color TV without it All with NTSC standards and COMPLEX sync. The RF output also includes an audio tone and STEREO signaling With colorbars, gray scale, crosshatch with dots. you can set and test quickly.

Checker TV Pro..PRICE: $499.95

The TV Jr is a small NTSC video generator with colorbars crosshatch with dots. white. red. blue green. and black screens Small enough to fit in your pocket. powerful enough to drive the largest projection TV!

Checker TV Jr....PRICE: $129.00

Computer & Monitor Maintenance, Inc.
1-800-466-4411 • 770-662-5633
http://www.computermonitor.com

BEST DEALER PRICING!

CABLE DIRECT

CONVERTERS • FILTERS
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH
VIDEO STABILIZERS

FREE CABLE TV CATALOG!

100% MONEY BACK GUARANTEE!

30 DAY FREE TRIAL!

Now you can tune-in your favorite cable TV programming and **SAVE $100'S - EVEN $1000'S** on premium **CABLE TV EQUIPMENT.**

VISA MasterCard

MODERN ELECTRONICS
1-800-906-6664
2609 S. 156TH CIRCLE • OMAHA, NE 68130
http://www.modernelectronics.com

MECI
340 East First Street
Dayton, Ohio 45402
Your Electronics Value Company

Tons of Electronics

Get your FREE catalog today and discover some of the best deals in electronics. We have thousands of items ranging from unique hard-to-find parts to standard production components. Call, write or fax today to start your subscription to one of the most unique catalogs in the industry, filled with super values on surplus electronic and hobbyist type items.

FREE CATALOG!

Checkout our 10,000 item on-line catalog http://www.meci.com

Order Toll Free
1-800-344-4465

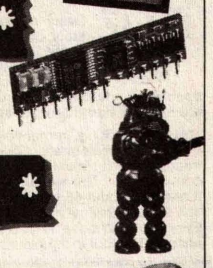
Why pay more? Call today!

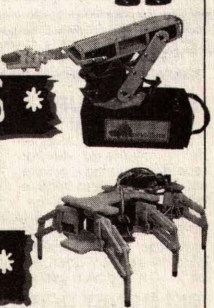
Fax Order Line
1-800-344-6324

MONDO • TRONICS'

ROBOT STORE

* KITS *
Your
* BOOKS *
Mailorder
* PARTS *
Source
* VIDEOS *
For
* MODELS *
Robots!
* MORE! *





(REQUEST OUR FREE CATALOG)

www.robotstore.com

800-374-5764

Or write to us:
4286 Redwood Hwy PMB #226
San Rafael CA 94903
Phone 415-491-4600 • Fax 415-491-4696
Email info@mondo.com

CIRCLE 251 ON FREE INFORMATION CARD

Dalbani

WWW.dalbani.com

$20.00 Minimum Order

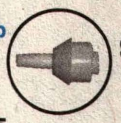
Swing Arm Magnifying Lamp

- Steel Shade supplied with a precise 3 diopter lens and a 22W fluorescent circling tube.
- Spring-Balanced 45" extension arm with 3 conductor
- Lamp included.

Color	Voltage / Freq.	Item #
White	120V / 60Hz	54-0120
Black	120V / 60Hz	54-0125

$34.95 Your Choice

Replacement Tip



Replacement Tip for Solder Sucker (Item#51-2560)

$1.29

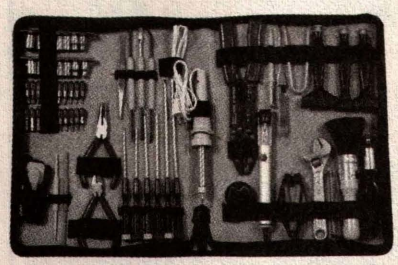
Item # 51-2565

Solder Sucker

$5.95

- 13" Extended
- Durable corrosion resistance plastic construction.
- Precision metal plunger
- Corrosion treated springs
- Insulated vacuum pulse

Item # 51-2560



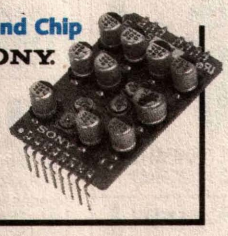
$59.00 Item # 50-058

68 Piece Computer Tool Kits

OVER 7000 NEW ITEM IN STOCK NOW

Original Sony Sound Chip

SONY



$5.75 Min. 5 pieces

SBX 1637-11
8-746-371-10

Item # 03-195

MAGNAVOX Remote Control

$5.95 Min. 5 pieces

Controls 3 Units
TV, VCR, Cable Box

Item # 82-1380

Solder Roll

$4.95

- 1 lb Spool
- Alloy 60/40,tin lead,non corrosive flux,Diam.1.0mm

Item # 51-1005

Digital Video Stabilizer

$16.95

Warning: duplicate copyright video tapes may be against certain federal and state copyright laws.

Item # 55-1265

Digital Multimeter

$9.95

Quality Test Equipment

Item # 50-3630

Aluminum frame Tool Case

$24.95

Item # 50-1890

Power Strip GEMINI II

$3.45

25 Joules, Six Outlets

Item # 40-1755

12 inch Quad Screen Observation System

PHILIPS

$199.95

Item # 38-0525

Photo Inkjet Color Printer

$129.95

Item # 95-7580

Desoldering Station

SOLOMON

$195.95

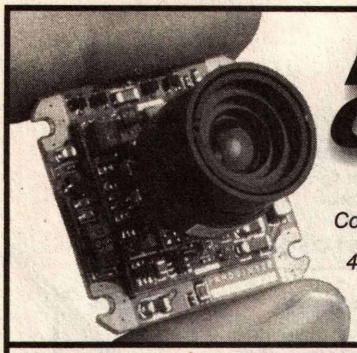
Item # 51-1985

CALL TOLL FREE 1-800-325-2264

SPECIAL $3.95 UPS 2DAY AIR
up to 5lb in the continental U.S.A. (plus 2.25 Handling)

CIRCLE 234 ON FREE INFORMATION CARD

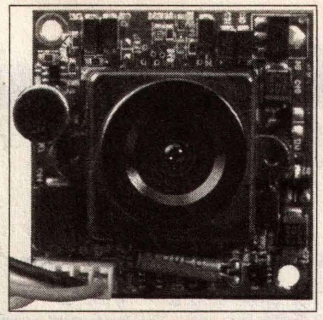
Micro Video Camera Sale



Ask for the Quick-Start KIT Accessory

MB-45cB
Color Video Camera
2.8mm Lens
45° Angle of View
$99.95
Size: 1.25" sq.

MB-650Ua
Black & White Video Camera with Built-In Audio & 4.3 mm Lens.
$89.95
Size: 1.18" sq.



Wireless Cameras

Wireless Camera Package Deals, include: one camera, one receiver and power supplies. (Receiver holds up to 4 cameras)

Wireless 4-Channel A/V Black/White & Color Cameras

Built-in Mic (on All models)
Cameras are shipped with 4.3mm lens. (Camera shown with optional lens.)

GFS-1001 (900MHz)
GFS-2002 (1.2Ghz)

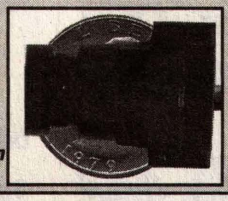
Wireless Transmitter & Receiver
2.4 GHz Video/Stereo Audio
ONLY $219.95

Dimensions: 2.5"(W) x 2.18"(H) x 3.28"(D)

Worlds Smallest Video Camera

No Bigger than the size of a Quarter! with CMOS Technology.

CM-550U -$69.95
Pinhole Camera Available:
CM-550P -$69.95
240 Line Horizontal Resolution
Size: 1.12"(L) .5"(W)



Micro Audio Receiver

- Audio Jack - RCA Female.
- Power Jack - 2.1 Female Barrel Jack.

MIC-300 -$39.95

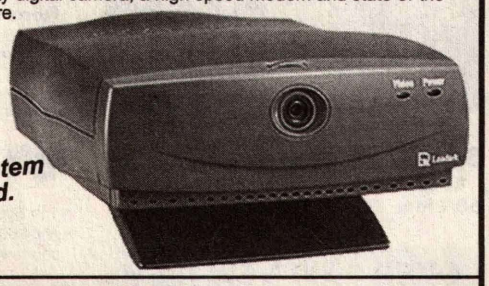
Video Conferencing

TeleEye has everything you need to do Color Video Conferencing. It comes with a built-in high quality digital camera, a high speed modem and state-of-the-art Audio/Video hardware.

Remote View Window
Up to 15 frames per second or VHS-quality resolution.

On-Screen Menus
Easy Control using your phone keypad.

$499.95
Stand Alone System No PC Needed.



FREE Polaris Product Catalogs

Outdoor Model Available $169.95

Interfaces with existing Camera Systems!

System includes:
- Monitor
- Camera/100 ft. Cable
- Camera Stand/Mount
- 2-way Intercom Station
- 100 ft. Intercom Cable
- VCRInterconnect Cable
- One Year Warranty

SCO-1 -$399.95
Observation System

Polaris Industries
http://www.polarisusa.com
800.752.3571
Polaris Industries 470 Armour Dr. Atlanta GA 30324 Tech Info: 404.872.0722 FAX: 404.872.1038

CIRCLE 222 ON FREE INFORMATION CARD

Battery Analyzer

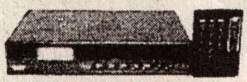
PC-Controlled Battery Analyzer
Cycle, Charge & Test with your PC
Print reports, plot graphs, expandable
$398

Tel: 800-673-3585
519-472-5566
Fax: 519-472-1702

LaMantia Products Ltd.

Download Demo:
http://home.rogerswave.ca/lamantia
lamantia@compuserve.com

CABLE TV BOXES



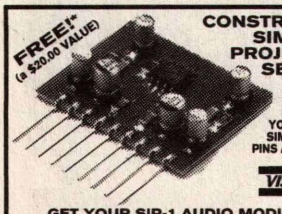
(WE'LL BEAT ANY PRICE!)
30 DAY TRIAL* 1YR. WRNTY. *FREE CATALOG
QTY. DISCOUNTS * DEALERS WELCOME!

1-800-785-1145

HABLAMOS ESPANOL

VISA MasterCard C.O.D

PRIVATE CABLE SYSTEMS



CONSTRUCT THOSE SIMPLE AUDIO PROJECTS FROM SESCOM SIPs

JUST APPLY SIGNAL, POWER AND OUTPUT CONNECTIONS AND YOU ARE READY TO GO. SIMPLE CONSTRUCTION, PINS ARE ON 0.1" CENTERS

VISA MasterCard Bank

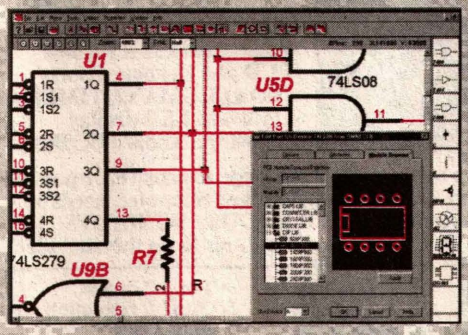
GET YOUR SIP-1 AUDIO MODULE TODAY
***ONLY $2.00 FOR SHIPPING AND HANDLING**
EXPERIMENT FOR YOURSELF TO SEE THE BENEFITS OF THESE DEVICES. THERE ARE 25 DIFFERENT DEVICES IN THE SIP PRODUCT LINE.

OFFER GOOD ONLY IN THE 48 STATES. OFFER ENDS DECEMBER 20,1999. LIMIT ONE REQUEST PER CUSTOMER. MUST BE PREPAID BY CREDIT CARD OR CHECK. MAILED 1ST CLASS, ALLOW 1-2 WEEKS FOR DELIVERY

SESCOM®
ORDERS 800-634-3457 • FAX 800-551-2749
OFFICE 702-565-3400 • FAX 702-565-4828
www.sescom.com • info@sescom.com
SESCOM, INC. 2100 WARD DR., HENDERSON, NV 89015
SESCOM, INC. is not responsible for inadvertent typographical errors and prices and specifications are subject to change without notice.

Electronic Design Automation for Windows

More Features
More Power
Less Money



Ivex 650 pin versions have no feature limitations like other low cost products on the market. Ivex WinDraft and WinBoard are the preferred choice for designers worldwide.

Take the Ivex challenge today. Try WinDraft Version 3.0 schematics for 30 days. We know you will find it to be the most powerful, full featured tool available, Guaranteed or your money back !

WinDraft®
Schematics **$250**
650 pin version

Full Featured Tools:
Hierarchical designs
Part scaling
Step & repeat
True-type text
Auto junction
Single click editing
Rubberbanding
Graphical part editor
Update parts
Global replace
Advanced Bill of Materials with sort options.
User Definable Electrical Rules Check
Annotation
Common netlist formats: (Accel, Protel, Pads, Pcad, Tango, wirelist, spice, etc.)
Import Orcad/SDT sheets/libraries
Assign net signal properties for PCB layout
Visual PCB footprint browser
Over 10,000 parts included
Windows 95/98/NT

WinBoard®
PCB Layout **$250**
650 pin version

Easy to install:
Multi layer designs (16)
Surface mount designs
Advanced Design Rule Check
Electrical DRC check and Real-Time DRC
Rotate and mirror
Single click editing
Pad stack editor
Global edit
Graphical part editor
Hundreds of footprints
Copper zone pour
Uses common netlist formats
Edit netlist on the fly
Output Gerber photo plot files
NC drill report
Bill of materials
Free web support

Ivex View
Gerber Viewer **$99**
Any size file

View and print any size file in standard Gerber 274-x format and most 274-D.

Visit the Ivex web site for complete product information and free product demos.

y2K COMPATIBLE

www.ivex.com

IVEX™
DESIGN INTERNATIONAL

Telephone: (503) 531-3555
e-mail: sales@ivex.com

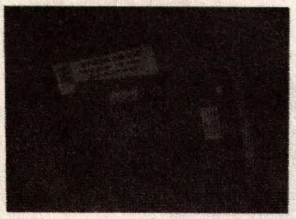
ADV5_1

PC PLACE

CIRCLE 319 ON FREE INFORMATION CARD

386 MINI-PC $83

1K PRICE
EVAL $295
8088 $27



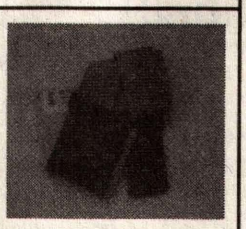
includes:
- -5 Serial,3 Parallel (32bit max)
- -Up to 8 meg ROM (27C080)
- -32k RAM exp. to 64Mbyte
- -Battery backed RT Clock
- -LCD and Keyboard ports
- -IRQ x15, DMA x2, TIMER x4
- -On-board LED display
- -Industry Standard PC Bus

Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

A to D D to A CONVERTERS

For PC or SBC
8,12,16 bit resolution
up to 24 channels
starting at $21 OEM (1k)
eval kit $75

$95 UNIVERSAL PROGRAMMER



FLASH, EEPROM, NVRAM, EPROM up to 8 meg (27C64-080). Adapters for micros, PLCC, etc. Parallel port version for notebook. FAST AND EASY TO USE.

LOW COST... LOW POWER...

LOW RISC!

QTY 1K PRICE
$1.99
EVAL KIT 7.00

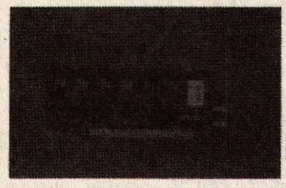
LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

COMPARE:	16C54	MV1200
OEM (1K) PRICE	$2.57	$1.99
RS232 PROGRAM DOWNLOAD	NO	YES
SINGLE CHIP OPERATION	NO	YES
BUILT-IN BASIC	NO	YES
EEPROM DATA MEMORY	NONE	64
PROGRAM MEMORY	768 OTP	1K FLASH
MATH REGISTERS	1	32
MAX INSTRUCTIONS / SEC	5M	20M
MAX COUNTER BITS	16	18
INPUT / OUTPUT BITS	12	15
A TO D COMPARATOR	NO	YES
HARDWARE INTERRUPTS	NONE	3

PINOUT:

RESET	1	20	VCC
PD0	2	19	PB7
PD1	3	18	PB6
XOUT	4	17	PB5
XIN	5	16	PB4
PD2/INT	6	15	PB3
PD3	7	14	PB2
PD4/TMR	8	13	PB1/AD1
PD5	9	12	PB0/AD0
GND	10	11	PD6

- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -



PC SOLID STATE DISK

$21 OEM (1k) eval kit 75.00
FLASH / RAM / EPROM
256K-16M PCMCIA/DIPS

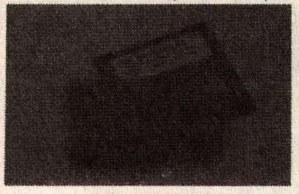
No More Hangups...

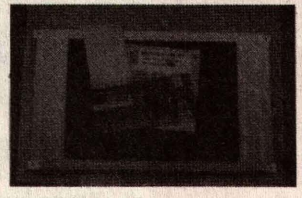
PC WATCHDOG!

Reboots PC OEM $21 EVAL $75

VGA LCD

640x480 controller for PC or SBC $27 oem $95 eval combo LCD/CRT version available





visit our web site: www.mvsweb.com

MVS BOX 850
MERRIMACK,NH 03054
(508) 792-9507

.MVS

5yr Limited Warranty
Free Shipping
Hrs: Mon-Fri 10-6 EST

www.unbound-tech.com **UTI** ***1-877-UNBOUND***

Development Boards, Microcontrollers, Kits, Control and Measurement

Development, Prototype and Testing

- **JCM Vulcan Logic Trainer**: Design and test digital circuits in minutes with this trainer and a breadboard. $32
- **JCM Advanced dig daughterboard** $39
- **JCM Analog Trainer**: Use on its own, or to complement to the logic trainer, test analog circuits in minutes. $45
- **UTI PIC-Micro Trainer**: This system gives you the flexibility to test and experiment with micro based designs, includes a 64K-bit non-volatile E^2 mem, and RS-232 and RS-485 drivers. $129
- **UTI Control Trainer**: Real world interface for the trainer series, with inputs and outputs for measurement and control, analog cond, relays, buffered dig I/O, and more. $69
- **JCM Cybug1 kit**, a great little robot kit for the hobbyist $32
- Prototyping breadboard to fit the above

Microcontroller Boards and Interfaces

These boards include voltage regulation, 64K-bit serial E^2, RS-232 and RS-485 drivers, interface with screw terminals and/or stackable expansion headers.

- UTI-P76F: A flash PIC micro dev board $169
- UTI-11A1: A 68HC11 based SBC $189

  Some interfaces available: $49–$99
  - 4 and 8 channel analog zero and span cct
  - 8 SPDT relays with 2A contacts
  - 2A dual H-bridge for motors and solenoids
  - Audio capture, 2-4 min of audio
  - Micro modem rates @ 2400 – 28.8
  - LCD, 2 line x 16 char, and 4 line x 20 char
  - Ambient temperature and relative humidity
- UTI-I2CM-XXX-X: Non-volatile I^2C **memory** boards **(up to 512Kb per board!)** $39

Serial Control and Measurement

- UTI-XX-232.485 Series: **measure inputs and trigger events over serial**, uses simple **ASCII protocol** $99–$299
  - UTI-05-XXX: 0-5VDC 4 channel 8 bit **A/D**
  - UTI-DI-XXX: 0-30VDC 4 channel digital **input**, adjustable trigger level
  - UTI-OC-XXX: 8 channel open collector **outputs**, opt 5V pull-up, drive relays or solenoids
  - UTI-RE-XXX: 4 SPDT **relays** w/ 2A contacts
  - UTI-PM-XXX: 2 channel **PWM** output with two buffered digital outputs, good for motor control apps, opt H-bridge version.
  - UTI-WM-XXX: **ambient temperature and relative humidity**, 8 bit resolution
  - More available....
- UTI– 232-485: Speak to an RS-485 device with your PC, extend 500' to other serial devices, or chain several UTI-XX-485 devices. $129

Other Exciting Products

- UTI-WC1: **Serial CCD Camera.** Board level, takes serial commands through RS-232 at up to 115K Baud, returns CCD data in various res. Great for pics and experimenting, PC S/W incl. $249
- UTI-SCL: **WinCam.Live.** Serial port based webcam system for your PC. $499
- UTI-SCP: **SecureCam Pro.** Remote access surveillance camera, event trigger, motion detection, outdoor encl. available $599
- UTI-ACC: Capture and play 2-4 min of **audio**, line level input, dry contact trigger $129
- UTI-MP-**XXX: serial RS232 radios,** 900MHz narrow band RF, ch selectable, 1000' range outdoor, combine with our control and measurement products for a telemetry system. $519

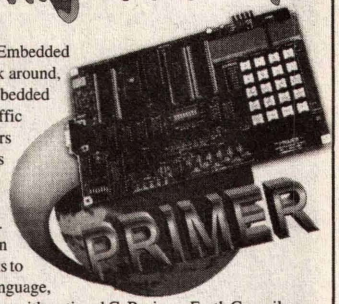
**** All prices in US$***
*****Shipping and handling not included***

We also provide affordable electronic design, consulting, assembly, and product development.

UTI Unbound Technologies Inc. 1-877-UNBOUND (1-877-862-6863)

#25-1725 30 Ave NE Calgary, Alberta, CANADA T2E 7P6
Tel: 403-291-0054 Fax: 403-291-0017
Payment by Cash, Chk, MO, COD
Call us to receive details via fax, mail or email.

World Passing You By?



Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!

Examples Include:

- **Measuring Temperature**
- **Using a Photocell to Detect Light Levels**
- **Making a Waveform Generator**
- **Constructing a Capacitance Meter**
- **Motor Speed Control Using Back EMF**
- **Interfacing and Controlling Stepper Motors**
- **Scanning Keypads and Writing to LCD/LED Displays**
- **Bus Interfacing an 8255 PPI**
- **Using the Primer as an EPROM Programmer**
- **DTMF Autodialer & Remote Controller (New!)**

The PRIMER is only $119.95 in kit form. The PRIMER Assembled & Tested is $169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade ($49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add $5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad ($29.95) installed. Satisfaction guaranteed.

EMAC, inc.

1985 - 1998
OVER *12* YEARS OF SERVICE

11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: http://www.emacinc.com

CIRCLE 306 ON FREE INFORMATION CARD

Home Automation

- World's Largest Selection!
- Best Customer Service
- Top Technical Support

Take a step into the future -- discover the latest in innovative home technology, from remote controls to high-tech toys to voice-activated systems. We will show you the ***smart*** (and easy!) way to automate your home.

Lowest Prices Guaranteed!

Call **800-SMART-HOME**
800-762-7846

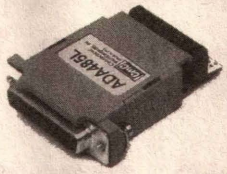
or visit us on the web@
smarthome.com
to order your *FREE* catalog today!

Order 24 Hours • 7 Days

SMARTHOME.COM
A Home Automation Systems Company

Dealers/Resellers ask about our SmartHome PRO Dealer Program 800-949-6255

RS232/RS422/RS485 Converters



CMC's low cost converters adapt any RS232 port for RS422 or RS485 operation. These converters provide your RS232 device with all the advantages of RS422 or RS485 including reliable high speed operation (up to 200 kbaud) and data transmission distances up to 5000 feet. Two AD422s can be used to extend any RS232 link up to 5000 feet. Completely transparent to the system; no software changes of any type are necessary.

RS232 TO RS485 2 wire

- **Makes your RS232 port an RS485 port**
- **Supports up to 40 RS485 devices**
- **Automatically determines data direction.**
- **Signal powered version available**

ADA485 (requires 9VDC)	$79.00
ADA485-1 for 110VAC	89.00
ADA485L signal powered	84.00

RS232 TO RS485 4 wire

- **Converts an RS232 port for use with RS422 or RS485 devices**
- **Supports up to 40 RS485 or RS422 multidrop devices**
- **Adds multidrop capability to RS232 devices**
- **Automatically determines data direction.**

ADA425 (requires 9VDC)	$89.00
ADA425-1 for 110VAC	99.00

RS232 TO RS422

- **Converts bi-directionally between RS232 and RS422**
- **Use as a short haul modem**
- **Plug in and go. No software changes required**

AD422 (Requires 9VDC)	$79.00
AD422-1 for 110VAC	89.00

Mention this ad when you order and deduct 5%
Use Visa, Mastercard or company purchase order

code N9G

CmC ***Connecticut microComputer, Inc.***
PO BOX 186, Brookfield, CT 06804 (203)740-9890

WWW.2CMC.COM **Fax:(203)775-4595**

Data Acquisition and Control

The ADR series of interfaces allow control of analog, digital and relay I/O via RS232 or RS485. Visit the web site for specs, applications and programs in VB, C, BASIC etc. (705) 671-2652

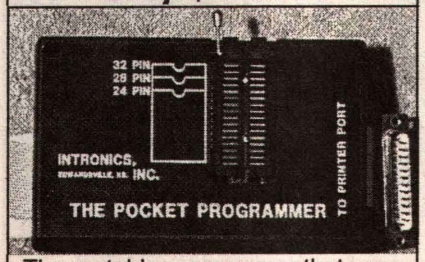
www.ontrak.net

Ontrak Control Systems Inc.

FOR 26 EASY WAYS to HELP · SAVE the EARTH CALL 1-800-488-8887.

Great consumer information is a shoe-in with our free Catalog. Call toll-free 1 (888) 8-PUEBLO or go to www.pueblo.gsa.gov.

The Pocket Programmer
Only $129.95



The portable programmer that uses the printer port of your PC instead of a internal card. Easy to use software that programs Eprom, EEprom, Flash & Dallas Ram. 27(C) / 28(C) / 28F / 29F / 29C & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, PLCC, 5-Gang, 874X, 875X MCU's, 40-Pin X 16 & Serial Eprom's, 82/74 Prom's and Eprom Emulator to 32K X 8.

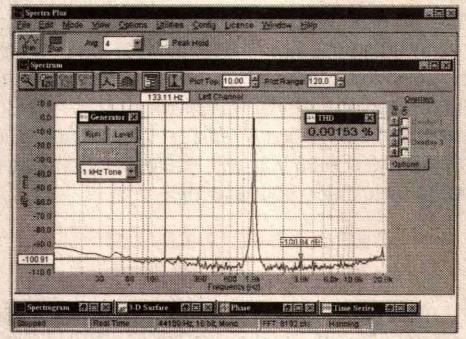
Same Name, Address & Phone # for 16 Years... Isn't it Amazing ?

Intronics, Inc.
Box 13723 / 612 Newton St.
Edwardsville, KS 66113 Add $5.00 COD
Tel. (913) 422-2094 Add $4.00 Shipping
Fax (913) 441-1623 Visa / Master Charge

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

- 20 kHz real-time bandwith
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes



Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card

Priced from $299

(U.S. sales only – not for export/resale)

DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com

PHS Pioneer Hill Software
24460 Mason Rd.
Poulsbo, WA 98370
a subsidiary of Sound Technology, Inc.

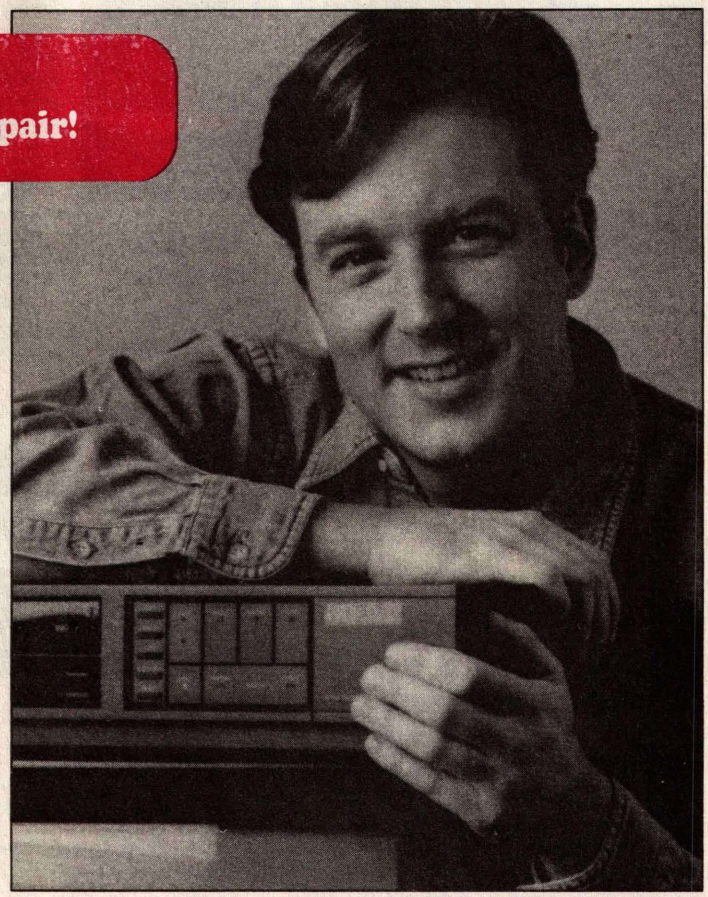
Spectra Plus
FFT Spectral Analysis System

Sales: (360) 697-3472 *Fax: (360) 697-7717* *e-mail: pioneer@telebyte.com*

PC PLACE

"I earned $1,000 on just 12 VCR repairs in one week"

A true statement by Paul B.* of San Pedro, California



How to cash in on skyrocketing field of VCR repair!

You too can earn up to $85 an hour, pocket $200 a day, double your income...in the high-profit field of VCR repair...part-time or full time. There are over 77 million VCR's currently in use in America today – a lot of business out there just waiting for you!

Here is a once-in-a-lifetime opportunity to go into a booming business of your own, make really big money starting right away, be your own boss and enjoy financial freedom and security.

It's easy to learn VCR cleaning, maintenance and repair at home in just a few short weeks through Foley-Belsaw's unique method which emphasizes the mechanics involved in 90% of all repairs, without dwelling on all the unnecessary basic electronics. This exclusive practical hands-on course was developed and proven over a long period of time in an actual VCR repair shop. It combines simple step-by-step lessons with easy-to-follow video cassette guidance. No special experience or electronics background is necessary. Just average mechanical aptitude and the ability to follow simple A-B-C repair procedures that are clearly outlined for you. And when you complete the course you will receive the School's official diploma attesting to your expertise.

Send coupon today for FREE Fact Kit. No obligation.

Don't miss out on this opportunity to give your income a tremendous boost. Send in the coupon NOW. Get all the facts and study them in the privacy of your own home. There's absolutely no obligation and no salesmen will call on you. So don't delay. Mail the coupon today!

"I started 3 months ago, now earn over $900 a week."
D.K., New York, NY

"Took in over $3,200 in the past 10 days!"
H.H., Denver, CO

"Doubled my income within 6 weeks."
R.B., Bakersfield, CA

*Last name withheld by request.

MAIL TODAY FOR FREE INFORMATION PACKAGE

Foley-Belsaw Institute,
6301 Equitable Road
Kansas City, MO 64120-1395

FOLEY BELSAW

CHECK ONE BOX ONLY FOR FREE INFORMATION KIT!

❑ **YES,** without obligation send me information on how I can learn at home to become a VCR technician. **62967**

- ❑ TV/Satellite Dish **31738**
- ❑ Electrician **95546**
- ❑ Computer Spefcialist **38502**
- ❑ Computer Repair **64876**
- ❑ Computer Programmer **35685**
- ❑ Networking Specialist **39489**

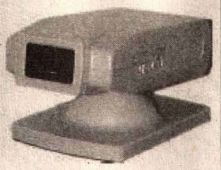
Name _____

Address _____

City _____ State _____ Zip _____

CIRCLE 335 ON FREE INFORMATION CARD

NOVEMBER SPECIAL, PRICE BUSTER DEAL.....
NEW, SHARP, YH-7B50, COLOR CCD CAMERA.

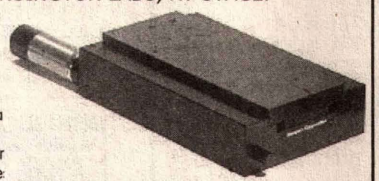


Now available for a fraction of its' original price. Great looking styling. Camera has a very stable, manually adjustable pan and tilit base. Base is removable for tripod mounting via standard 1/4-20 mount on bottom. Front panel LED power indicator. Excellent video performance packaged in a sturdy 2.7"W x 1.4"H x 5.8"L, 11 oz. package. Simply connect camera to any "Video Input." RCA cable supplied. Camera has 5.6mm lens with fixed focus from 18" to infnity. No adjustment required! Power is 6VDC from power adapter also included. 1/3" CCD, 300Lines resolution 25% better than standard VHS! Auto white balance. Perfect fro any general purpose video application.

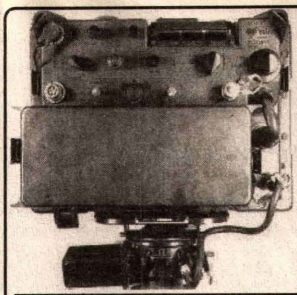
Brand new, in original sealed boxes. Don't miss out on this super special deal.

YH-7B50 COLOR CAMERA...$59ea. Super deal 2 for $99

ULTRA PRECISE, KENSINGTON LABS, XY STAGE.



Model 8500-6X, 6"X6" of high performance travel. One of the best linear stages available. Highly repeatable, ultra-precise. Precision ground surfaces result in unmatched laboratory-grade performance. Linea scale, internally attached to the table, drivetrain errors not measurable wher attached to the motor. System provide 100 mm. Built from stress relieved 7075 aluminum. Crossed-roller bearings for excellent stiffness, load capacity and lifetime. Combined with a very low friction preloaded leadscrew and DC servo motor drive provides 20,000 hour MTBF. 100 mm/sec maximum speed and >50kg load capacity. Size: 15"L x 9"W x 2.75"H Regular price > $4Kea. X&Y stage with motors. USED, Very good condition. *SPECIAL, 8500-6, XY STAGE.....$1295*

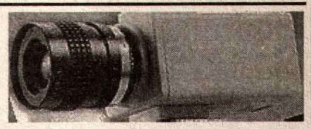


PORTABLE, PERIMETER, PROTECTION PPS-15V, SURVEILLANCE RADAR SYSTEM

Up to 3000 Meter range. Provides audible indication of objects w/alarm. Control panel with LED display of battery, signal strength, range and azimuth. Can be operated remotely via supplied cable and detachable control panel. 12VDC or 28VDC powered. Includes heavy duty, military, aluminum transit case, headphones tripod and manual. Only 14 lbs. Latest flat antenna design. Motorized sweep.Truly unique.

NOVEMBER SPECIAL.....$1295

NEW! 0.008lux, COLOR, NIGHT VISION CAMERA! UNBELIEVABLE PERFORMANCE. Our GMV-2K, DOES it in COLOR!



For covert, military and scientific applications that must be color, this is it. Performance is enhanced through low speed electronic shuttering and digital frame memory. With an auto iris lens, 24 hour monitoring is possible. Auto sensitivity mode starts as it becomes dark. Eight Gain/Shutter modes are user selectable. Normal, X4, X8, X16, X24, X32, X64, X128. These provide frame rates of 60, 15, 8, 4, 3, 2, 1, and 0.5 frames per second. Auto/Manual white balance. Aluminum housing with dual 1/4x20 mounts. Specs: 1/3" CCD, with 291K pixels, 320 Lines, <1 Lux std. mode sens., 12VDC @200mA, Std. video out on BNC. Size: 54mmx50mmx94mm long. With pwr. adapter. All functions can be externally controlled via an 8 pin mini DIN. Uses std. c-mount lens not included.

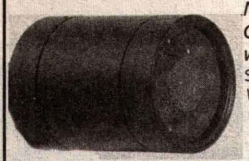
Special Item, GMV2K.....$589ea.

4mm, fl.4A/I lens with custom cable.....$119ea.

WORLDS SMALLEST •••100mW••• VIDEO TRANSMITTER, ON SALE

Incredibly only 0.98" x 0.8" x 0.037" in size. Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for. **Shown actual size.** Smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV Included. Perfect with our GM1000A. Both will fit in a cig. pack with battery!

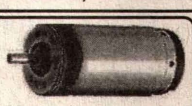
NOVEMBER SPECIAL TVX-100.....$159 or with GM1000A CAM....$209



NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN'" GO UNDERWATER (to 60 ft.) Waterproof B&W CAMERA with INTERNAL, INFRA-RED ILLUMINATOR!

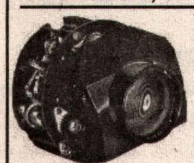
Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustabe mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25"diam. X 2" long. With 60 ft. cable. Great for general outdoor use also. SPECIAL, GM-300KIR...$199ea.

MINIATURE and, PRECISE, PORTESCAP, SWISS, GEARMOTOR.



State of the art "ironless" type, mini motor type M11-210-54-0 with approx: 40:1 gearbox. Size: 16mm d. x 43mm L Operating parameters: @6VDC input, 8mA, 141RPM No Load, @ 12VDC input, 12mA 290RPM No Load

PORTESCAP, TYPE B: $15ea. 2 for $27, Special....10 for $125



MOTORIZED 10X ZOOM, SURVEILLANCE LENS

New, 11mm to 110mm, f1.8, C-Mount, Fujinon, industrial quality optics paired with precision drive enable smoooth remote operation of FOCUS, ZOOM and IRIS. Unit is open frame, black anodized alum. structure supports the sophisticated drive. Two models: Mod Z5 std, or Mod Z10 has HP optical encoders for position feedback (128ppr) on zoom & focus Edmunds sells the lens w/o drive for $869ea. Motorized unit sells for >$2000. Very limited quantity. *Model Z5.....$349ea. Model Z10.....$399ea.*

New ZOOM LENS CONTROLLER.....$169ea.

6V@12AH SEALED, RECHARGEABLE, BATTERY

New Panasonic, LCR6V12PI. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9"L x 3.7"H x 1.9"D **2 for $20, or 10 for $89**

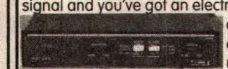
NEW, 2.4GHz VIDEO + STEREO AUDIO/TRANSMITTER with SONY, CCM-PC5 COLOR CAMERA.

Originally sold for $500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tiliting base, front panel LED pwr. indicator and sensitive built in electret mic, providing excellent audio and video performance from one compact package. Simply connect camera to the completely self contained 2.4GHz transmitter. All cables supplied. You can transmit up to 700 feet clear line of sight! Companion matching receiver works with any TV or VCR. Internal patch antennas. Camera has adjustable focus 6mm lens. (1" to infnity, macro capable) Auto power off when the privacy shutter is closed. Power is 7-13VDC. (all pwr. adapters and cables included) 1/3" CCD, 330Lines res. 35% better than standard VHS! Can als be used to transmit VCR oputput to another TV.

SPECIAL 2.4GHz SONY-ASTROVIEW....$189ea. or 2 for $339

2.4GHz TRANSMITTER & RCVR. only less camera.....$129

Brand New, Video Motion Sensor. Model VM10. Attach to any standard video signal and you've got an electronic "watchman" diligently watching the entire scene. Or any adjustable sized area within the scene. Such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac powered. Adjustable sensitivity. Video loop through. *NEW VM10...$189*



ULTRA MINI and WEATHERPROOF, "LIPSTICK" CAMERA

Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <1ounce! IR SENSITIVE. 23mmdX50mm, 36" cable with BNC video & DC barrel jack. PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 once! Size only 23mm d.x35mm long. Think of the places you could put this little jewel.

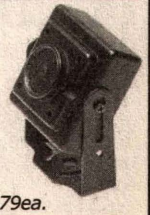
SPECIAL $99ea., GM-200K-STD or PINHOLE lens

ULTRA MINI, WEATHERPROOF, NEW "COLOR LIPSTICK" camera.

For those applications that must be color, this is it. Black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 400 Lines resolution, <1 Lux sensitivity, AGC, Auto Shutter. 12VDC @180mA, 4.3mm, 78° FOV lens, A real glass lens. Std. video out. Size: 32mm diam. X 65mm long. 24" leads with RCA jack and DC jack. Ready to go! with power adapter.

SPEACIAL, GM-400K.....$199

NEW, "STEALTH CAM", MICRO, with AUDIO!



The sleek aluminum housing fits like a glove! Removeable mounting bracket and a 1.3M cable with BNC vid., RCA aud., (internal mic) & DC barrel jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "STEALTH CAM". 1/3" CCD, 410 Lines, 0.3 Lux, AGC, Auto Shutter. Pwr. from 9 to 12VDC @110mA, 250k pixels, Std. model, 4mm, 78° FOV lens, Pinhole model, 90° FOV. A real glass lens. Focus from 10mm to infinity. NTSC video out. Only 1.7 ounce! SENSITIVE to IR. Size Std: 30mm sq. x 29mm d. PH is 16mm d, **WARNING:** Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS. *GM-2000-STD or Pinhole, w/audio.....$79ea.*

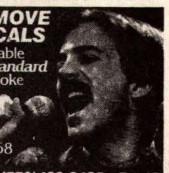
PLEASE FAX US A LIST OF YOUR INTERESTING ITEMS for SALE.

CIRCLE 283 ON FREE INFORMATION CARD

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM
WE BUY TEST EQUIPMENT AND COMPONENTS.
VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 54501A 100MHZ DIGITIZING SCOPE	$1300.00	HP 4935A TRANS.IMPAIRMENT TEST SET	$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	$1000.00	HP 5006A SIGNITURE ANALYZER	$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	$1000.00	HP 8662B 1MHZ-1300MHZ RF PLUG	$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	$700.00	FIP 575 MICROWAVE COUNTER	$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	$250.00	FLUKE 95 50MHZ SCOPEMETER	$550.00
HP 5370A 100MHZ U.T.I. COUNTER	$400.00	LECROY 7200 400MHZ O-SCOPE	$1000.00
HP 3586C LEVEL METER	$750.00	TEK 475 200MHZ O-SCOPE	$500.00
HP 436A POWER METER W/O SENSOR&CABLE	$500.00	TEK 465 100MHZ O-SCOPE	$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC ANALYZER	$3500.00
HP 3437A 3.5DIGIT SYSTEM VOLT METER	$250.00	TEK 1240 LOGIC ANALYZER	$750.00
HP 3455A DIGITAL MULTIMETER	$250.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	$1400.00
HP 3456A DIGITAL MULTIMETER	$400.00	TEK 11401A 500MHZ PROG O-SCOPE FRAME	$750.00
HP 3336C SYNTHESIZER/LEVEL GENERATOR	$800.00	TEK 7854 400MHZ OSCILLOSCOPE FRAME	$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	$250.00
HP 5335A 200MHZ COUNTER	$600.00	TEK 7A26 200MHZ VERTICAL PLUG	$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	$1000.00	TEK 7B80 400MHZ TIME BASE	$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	$125.00
HP 1740A 100MHZ OSCILLOSCOPE	$250.00	TEK 7S12 SAMPLING PLUG	$250.00
HP 6034A 60VDC-10A POWER SUPPLY	$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	$1000.00
HP 6269B 40VDC-50A POWER SUPPLY	$800.00	TEK AM503 CURRENT PROBE AMPLIFER	$250.00
HP 6553A 40VDC-12.5A POWER SUPPLY OPT.J01	$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	$400.00
HP 6632A 20VDC-5A POWER SUPPLY	$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT.J03	$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	$1100.00

SINGERS! REMOVE VOCALS



Unlimited, Low Cost, Instantly Available Background Music from *Original Standard* Recordings! Does Everything Karaoke does...*Better and* gives you the **Thompson Vocal Eliminator™**
Free Brochure & Demo Tape.
LT Sound Dept **EN**
7988 LT Parkway, Lithonia, GA 30058
Internet-http://www.LTSound.com
24 Hour Demo/Info Request Line (770)482-2485 - Ext 49
When You Want Something Better Than Karaoke!

FCC License Preparation
RADIOTELEPHONE LICENSE
Electronics Tech, Avionics, Marine & Radar
Homestudy--Fast-Easy & inexpensive.
Manuels-Audio-Video-pcdisks-Q&As
Guarantee Pass-see at www.wptfcc.com
Details-**800-800-7555.WPT Publications**
4701 NE 47ST, Vancouver, WA 98661

SURVEILLANCE HIDDEN CAMERAS
DIRECT FROM MANUFACTURER--BEST PRICE IN THE MARKET

Ultra miniature hidden camera, in dome, smoke or motion detector w/ mic. B/W or Color. Wide view angle. Low light sensitivity + super sharp images, plus video and audio output. From $159.00. Also 1/3" B/W board Cameras w/mic, starts at $79.00 USD. Wireless hidden camera, start at only $249.00 USD. Plus $5.95 for S/H. Whole/Retail Welcome. COD, Check, Money Order or Visa/MC.
BOLIDE INTERNATIONAL CORPORATION
PH: (800) 355-0895 or (626) 575-8178
9660 Flair Drive #218, El Monte, CA 91731
http://www.bolideamazingproducts.com/

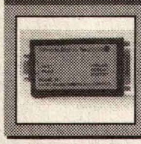
MAY THE SOURCE BE WITH YOU
Don't let the dark forces of ignorance defeat you. Tap into the source of free or low-cost government publications--the free CONSUMER INFORMATION CATALOG.
Call toll-free **1-888-8 PUEBLO.**
Or set your coordinates for our web site:
www.pueblo.gsa.gov

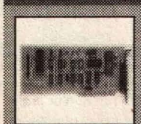
BUGGED??
EAVESDROPPING is unbelievably widespread! Electronic Devices with amazing capabilities can be monitoring your telephone and room conversations RIGHT NOW! Are you sure you're safe? **FREE CATALOG tells you fast!** Includes Free Bonus details on fantastic opportunities now open in Counter-Surveillance field. Exciting, immensely interesting and EXTREMELY profitable (up to $250 hr) full/part-time income. Call Now! **1-800-732-5000**

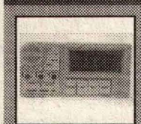
CONTROL
RELAYS • LIGHTS • MOTORS
MEASURE
TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY
INPUT
SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 ..... $79

• PLUGS INTO PC BUS
• 24 LINES DIGITAL I/O
• 8 CHANNEL 8 BIT A/D IN
• 12 BIT COUNTER
• UP TO 14K SMP/SEC

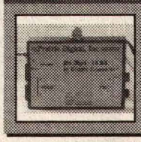
MODEL 45 ..... $189

• RS-232 INTERFACE
• 8 DIGITAL I/O
• 8 ANALOG INPUTS
• 2 ANALOG OUTPUTS
• 2 COUNTERS-24 BIT

MODEL 100 ..... $279

• 12 BIT 100 KHZ A/D
• 4 ANALOG OUTPUTS
• 3 TIMER COUNTERS
• 24 DIGITAL I/O

MODEL 150-02 .... $179

• RS-232 INTERFACE
• TRMS, 20 AMPS
• 12 BIT A/D
• OPTO-ISOLATED
• COMPLETE DMM

MODEL 40 ..... $109

• RS-232 INTERFACE
• 28 LINES DIGITAL I/O
• 6 ANALOG INPUTS
• PWM OUTPUT

MODEL 70 ..... $239

• RS-232 INTERFACE
• 18 BIT A/D
• 5.5 DIGIT
• UP TO 60 SMP/SEC

Prairie Digital, Inc.
PHONE 608-643-8599 • FAX 608-643-6754
920 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 315 ON FREE INFORMATION CARD

Automate Your Home Using Your PC and HomeSeer!

Home Automation Software for Windows

* Built-In Web server for Internet Access; remote control your home!
* Supports many X10 devices including Leviton, SwitchLinc, RCS HVAC, X10 Pro, CM11A, CM17A
* MSAgent, Voice Recognition, Infrared control, VBScript for Powerful scripting
* Send email, launch apps, speak, send infrared in response to X10

Only $39.95
FREE TRIAL at www.kenware.com
Keware Technologies LLC
Tel: (603)-471-2816
email: sales@keware.com

5 Axis Robotic Arm $195.00 *Plus S&H*

Lynxmotion

You can build this Robotic Arm
Impressive, fast, accurate, and repeatable motion. Any computer or micro capable of sending 2400 or 9600 baud serial data can control the arm. It can even be controlled from a Basic Stamp. This robot arm makes a great foundation for many AI and motion control experiments. Position the arm in an X, Y, Z, grid with a joystick or keyboard using the new RoboMotion for Windows. The kit includes the hardware, structural components, Hitec servos, pre-assembled SSC servo controller, DOS and Windows software, and an illustrated assembly manual. Camouflage paint not included.
We have many more cool robots, check out our web page or ask for our free catalog!
Lynxmotion, Inc.
104 Partridge Road
Pekin, IL 61554-1403
www.lynxmotion.com
Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

BK PRECISION®

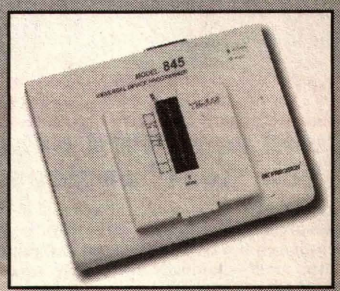
The 5300 Series, one of the world's finest digital multimeters. The best of the ASYC II Series, it has the best accuracy, a built-in counter, and displays AC voltage as resistive power or dB (impedance selectable), saving you the time of making the calculation. A careful examination of the performance features and user-conscious design will tell you that you hold a superior DMM in your hand, designed with measurement capability needed by users who demand the best.

MFG	MODEL	ACC'Y	LIST	SPECIAL PRICE
B&K	5360/MX53B	0.1%	$229.00	***$129.00***
B&K	5380/MX55	0.025%	$309.00	***$139.00***
B&K	5390/MX56B	0.025%	$325.00	***$149.00***
	(resistive power on model #5390/MX56B)			

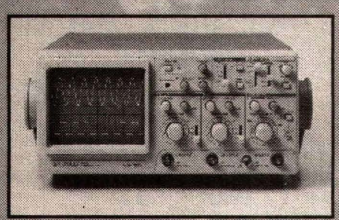
• meters made in France by Metrix for B&K, feature 50,000 count capability, bargraph, true RMS, mains disturbance indication, good transient protection, a wide temperature range, conform to IEC 1010 class 2 safety compliance & 3 year warranty

Universal Device Programmer & Logic IC Tester Model #845

The 845 is a software expandable universal device programming workstation that supports a wide variety of programmable devices with the added capability to test digital ICs. It is the most sophisticated low-cost programmer available today. A unique hardware/software architecture enables the Model 845 to easily grow in support and engineering software design capabilities as quickly as your device library requirement. State-of-the-art universal programmer offers you the most advanced programming facilities with the most user-friendly interface. Since each pin is software addressable, new part numbers can be added to the list of supported devices through software upgrades. The 845 interfaces with IBM, PC, XT, PS/2, AT, 386, 486, Pentium, portable or compatible personal computers. The standard pack-age allows you to directly connect to your PC through any standard parallel printer port (no special interface card or special modules needed).

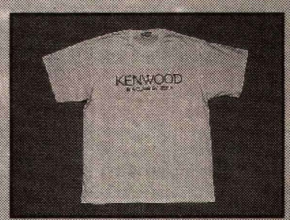


MODEL	DESCRIPTION	REGULAR	SALE
840	Eprom Programmer (single socket)	205.00	192.95
841	Eprom Gang Programmer (4 sockets)	260.00	251.95
842	Universal Programmer	695.00	611.95
843	Universal Programmer (parallel port interface)	795.00	699.95
845	**Universal Programmer (parallel port interface) Windows based**	**1295.00**	**1139.95**
846	Universal Programmer (parallel port interface)	495.00	435.95
847	Universal Programmer (4 sockets, parallel port interface)	595.00	523.95



KENWOOD

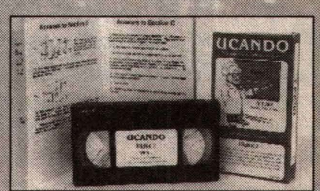
MODEL CS-4125
20 MhHz, 2 Channel Oscilloscope, with probes & 3 year warranty
Suggested Price $595.00
SUPER SPECIAL $389.00 w/free t-shirt!!!



MODEL	DESCRIPTION	REGULAR	SUPER SALE PRICE
CS-4135	40 MHz, 2 CH, 12 kV CRT w/scale illumination, 3 year warranty	855.00	***685.00 w/free Kenwood t-shirt!***
CS-5350	50 MHz, 3 CH, Delayed Sweep, w/Readout & Cursors, 3 year warranty	1650.00	***1235.00 w/free Kenwood Sweatshirt!***
CS-5355	50 MHz, 3 CH, Delayed Sweep, 3 year warranty	1485.00	***1115.00 w/free Kenwood Sweatshirt!***
CS-5370	100 MHz, 3 CH, Delayed Sweep, w/Readout & Cursors, 3 year warranty	2035.00	***1525.00 w/free Kenwood Sweatshirt!***
CS-5375	100 MHz, 3 CH, Delayed Sweep, 3 year warranty	1815.00	***1360.00 w/free Kenwood Sweatshirt!***

Electronic Training Videos From UCANDO

MODEL	DESCRIPTION	REGULAR	SALE
VT401	AM Radio: Major stages of AM, signal conversion, signal detection, audio reproduction, AM stereo. 61 Minutes	44.95	39.95
VT402	FM Radio Part 1: Bandwidths, RF amplifier, mixer-oscillator, IF amplifier, limiter FM detector. 58 Minutes	44.95	39.95
VT404	TV Part 1, Intro to TV: Gain an overview of the television system and how the stages work together. 56 Minutes	44.95	39.95
VT405	TV Part 2, The Front End: UHF-VHF tuning stages, automatic fine tuning, remote control. 58 Minutes	44.95	39.95
VT406	TV Part 3, Audio: The sound strip, stereo TV, secondary audio programming, professional channels. 57 Minutes	44.95	39.95
VT501	Understanding Fiber Optics: Basic fundamentals, cable design, connectors, couplers, splicing. 58 Minutes	44.95	39.95
VT502	Laser Technology: Laser theory, types of lasers, applications, safety precautions. 57 Minutes	44.95	39.95



SAVE EVEN MORE!
Buy any six videos for only $216.00. Order your UCANDO videos today!

PRINT™
Products International

Call, fax or email today for complete specs on any of the above products, and a copy of our 84 page test and measurement instrument catalog

8931 Brookville Rd * Silver Spring, MD, 20910
800-638-2020 * Fx 800-545-0058 * www.prodintl.com * sales@prodintl.com

CIRCLE 264 ON FREE INFORMATION CARD

Direct from Manufacturer
We will beat any competitor's price

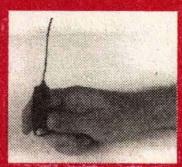
World's Smallest Wireless Video Camera!

- Transmits video up to 1000 ft.
- Runs on 9V battery for 12 hrs.
- Can be built into just about anything (beeper, clock, etc.)

World's smallest plug & play system about 1" x 1"

We also carry:
- Color micro video cameras
- B&W micro video cameras
- Hidden cameras
- Custom video systems
- Countersurveillance

& More

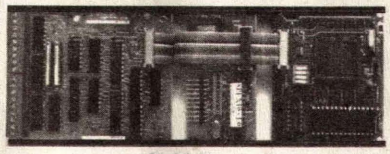


Looking for Distributors

Call for a free catalog (305) 667-4545
SECURETEK Fax (305) 667-1744
7175 SW 47 St. #205 • Miami, FL 33155

CONTROL YOUR WORLD
Modular, Open Source Automation

Digital Input From **$40**
Controllers From **$75**



X-10 Control From **$47**

Event control software included
Build Custom controllers for -
** Home Automation
** Machine Automation
** Security
** Robotics

Low Cost Microcontroller boards, kits & applications
ZORIN http://zorinco.com or call (206) 282-6061

The Hack & Crack Bible on CD-ROM
Includes all Software, Documentation, Plans, and PCB Layouts!

Unlock the secrets of:

Only $29.95

- DSS & Smart Cards –Programming & Schematics
- Cable Test Devices
- Sony Playstation –Mod Chip/CD Backups/Emulation
- Backup Sega & SNES Console Cartridges
- Sega & SNES Emulation on your PC or Mac
- Warez – where to find them on the Internet
- Cellular Hack/Phreak/Mod
- *And Much More!*

PC & Mac Compatible CD-ROM
We accept
VISA • MasterCard • AmericanExpress
To order, call Worldwyde @ **1-800-773-6698**
21365 Randall Street • Farmington Hills, MI 48336
Visit us on the web at www.worldwyde.com/hack

CABLE SECRETS!!!
Build your OWN cable box "test" devices!

Why pay $100.00 or *more* for a "test" device that someone *else* made? Make your own! Includes complete source code and plans for the most commonly used cable boxes. *Unlock all of the channels on your box!*

Or start your own lucrative business!

Complete source code $79.95
Code for individual boxes $29.95

DSS SECRETS – Vol. 2
Step-by-step instructions on programming your own DSS access card. *Unlock all channels on your own card!* This is the most current information on the market! Includes software, plans, and hardware sources. Book & CD-ROM.

DSS Secrets Vol. 2 ..... $49.95

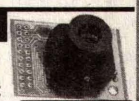
VISA • MasterCard • AmericanExpress
To order, call Worldwyde @ **1-800-773-6698**
21365 Randall Street • Farmington Hills, MI 48336
Visit us on the web at www.worldwyde.com

PIC Programmer Kits

Super Value!
$19.95 +S&H $4.95*
Code: CPS96

Program all 8, 18, 28 & 40 pin PICs in the 12C5xx, 14000 and 16Cxx series (except 16C54-58). All components, PCB and Instructions included. Parallel port of PC is used with straight through (25 pin) cable (not supplied). Kit uses the P16PRO shareware which is downloaded from the web and registered for $20. Can program 64 pin PICs with adapter (not supplied). For more info and other PIC programmers visit **www.electronics123.com**

Digital Camera module

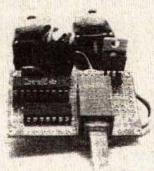


1/4" CMOS Camera Module, Black & White, with digital output. Size: only 1.38"x1.14". Lens: f7.4mm, F2.1 FOV 32 deg x 24 deg. Pixels 384x288. Scanning: Progressive. Video Output: digital 8bit. Programmable features. Shutter: 1/50 to 1/5000 sec. Power Supply, 5VDC. Standby Current <10mA. Needs regulated power supply. *S&H to Canada is $7.95

$69.95 +S&H $4.95*
Code: CM4881

Toll Free: 1-888-549-3749 (USA & Canada)
Tel: (330) 549-3726. Request a FREE catalog or visit us at: www.electronics123.com for more products.
Amazon Electronics, Box 21 Columbiana OH 44408

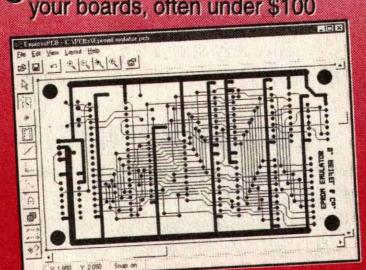
Servo or Stepper Control From Your Serial Port!
Only $29.95 +S&H



Intelligent Products
79 E. Daily, #127
Camarillo, CA 93010
(805) 384-0579
(805) 389-1757 FAX

PCB LAYOUT
Software For Windows - *FREE*

1. Download our board layout software
2. Design your 2 sided plated-through PCB
3. Send us your layout over the Internet
4. In 2-3 business days, UPS delivers your boards, often under $100



www.expresspcb.com

Printed Circuits in Minutes Direct From LaserPrint!

8 1/2" x 11"
* Or Photocopy
**Use standard household iron or P-n-P Press.

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch

Press-n-Peel

Use Standard Copper Clad Board
20 Shts $30/ 40 Shts $50/ 100 Shts $100
Visa/MC/PO/Ck/MO $4 S&H
Techniks Inc.
P.O. Box 463
Ringoes NJ 08551
ph. 908.788.8249 fax 908.788.8837
http:\\chelsea.ios.com\~techniks
Retail Dealer Inquires Invited

www.jm-micro.com

PIC In-Circuit Emulator for the PIC16Cxx from $295
PIC Programmer $155
80C552 (8051) Development Training System $235
68HC11 SBC $120
ROMY-16 EPROM Emulator from $195
Universal Microprocessor Simulator/Debugger (including **Assembler**, and **Disassembler**) $100 each CPU

J&M **Microtek, Inc.**
83 Seaman Rd, W Orange, NJ 07052
Tel:(973)325-1892 Fax:(973)736-4567

10Hr Phone Recorder $69
Records both sides of conversation automatically

Telephone Scrambler $159 ea. or2 for $149 ea.
Secure phone conversations with this high tech "rolling code" scrambler. Thousands of codes;Easy connection. Requires one at each end.

Voice Changer Phone $99
Disguise your voice with this phone. 16 Pitches;Make your voice deeper or higher. Men can sound like a women. easy to use.

5 Hr. Phone Recorder Touch-tone decoder $159
Records both sides of conversation including phone numbers dialed

Phone Information Recorder $169
Records both sides of conversation along with the number dialed Records name and number of callers (requires Caller ID service)

PC Telephone Recorder $119
Use your PC to record phone calls. Windows 95, Sound blaster compatible sound care 486 or higher PC required

Phone Tap detector $159
Protect your phone against phone taps,eaves droppers and RF bugs.

Mini Bug Detector up to 2Ghz $119
Detects RF "Bugs", Video Transmitters and wireless microphones from 5Mhz to 2 GHz. LED Bargraph and Audible alarm

VISA•MC•Money Orders •US & Canada Only
NO CHECKS • NO COD •Add $6.95 S/H

www.mscelectronics.com

MSC Electronics
PO BOX 461 Jessup, MD 20794
(301) 497-1600
FAX (301) 497-1925

VISA MasterCard

FRIENDLY LITTLE MICRO CONTROLLER

$149 (single)

...packs a ***MEAN*** punch
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •

Intec Automation Inc.
www.steroidmicros.com
v: 250-721-5150
fx: 250-721-4191

BREADBOARD KITS
USED BY NASA
NOW AFFORDABLE TO YOU
30% OFF
www.pulseresearchlab.com/products/breadboarding

PC BOARDS
Low Cost, Precision-Made PC Boards From Your Gerber/NC Drill Files

Put your CAD program to work for you!

PCB Milling

- Milling
- Drilling
- Routing

www.pcbmilling.com FAX: (703) 818-0071

VIDEO SYNC GENERATOR

Restores Horizontal and Vertical Sync Lines from Distorted Video

Lost Sync

Restored Sync with VSG

For Free Information Package and Pricing

VISA Call (219) 233-3053 MasterCard
www.south-bend.net/rcd

R.C. Distributing, PO Box 552, South Bend, IN 46624

PIC PROJECTS
Book & CD-ROM

Many PIC Projects for Beginners & Experts!
Includes Software, Documentation, and PCB Layout

Book & CD Only $24.95

- LCDs
- X10 — Home Automation
- Keypads
- Serial Port Interface
- On-Screen Displays
- Robotics
- Data Logging
- Serial-Parallel
- And Many More!

PIC Programmer
Programs all PIC16C55x/6x/7x/8x/9x, PIC 16F8x, and PIC12C devices. Optional ZIF adapters for SOIC & PLCC. Includes *all* necessary software.
Only $39.95

Buy *Both* for $59.95

We accept
VISA • MasterCard • AmericanExpress
To order, call Worldwyde @ 1-800-773-6698
21365 Randall Street • Farmington Hills, MI 48336
Visit us on the web at www.worldwyde.com/pic

COVERT CATALOG2000

BRAND NEW!

The Latest, Up-to-date, Hands-on Supplier and Source Guide for:

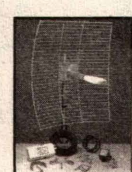
- Electronic surveillance equipment
- Covert video cameras and transmitters
- Counter measures gear
- Entry supplies
- Electronic tracking systems
- Computer surveillance and remote viewing

Equipment, exact addresses and ordering info from 15 countries!! 220 pages — $39.95

II 3555 S El Camino Real, San Mateo, CA 94403
Phone 650-513-5549 ■ fax 650-728-0525 or
www.intelligence.to (no "dot com")

!!! BROADCAST EQUIPMENT !!!
We manufacture & carry Stereo FM Transmitters, RF Amplifiers, Low Pass Filters, Antennas, DJ Mixing Boards & Consoles, Mics, Compressor/Limiters, Digital Reverbs, Automation Software, RF Test Equipment, RF Parts including BGY133's, and much more! Call For Free Catalog.

Progressive Concepts
BOX 586 STREAMWOOD, IL 60107
(630)736-9822 FAX:(630)736-0353
VISA MasterCard

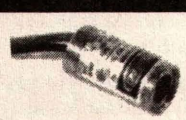


CHALLENGER SYSTEM
31-Channel Complete $240
Other Systems Available
5 Year Warranty
FREE SHIPPING

Wireless Internet & TV
WIRELESS CABLE - IFTS - MMDS
ATV - INTERNATIONAL - DIGITAL
Amplifiers • Antennas • Books • Components
• RF Frequency 2100-2700 MHz
• SASE For ***"FREE"*** Catalog or Send $1

PHILLIPS-TECH ELECTRONICS
P.O. Box 13074 • Scottsdale, AZ 85267-3074
CATALOG/INFO: 480-947-7700
ORDER LINE: 800-880-MMDS
FAX LINE: 480-947-7799
WEBSITE: www.phillips-tech.com
E-MAIL: product@phillips-tech.com
Visa • M/C • AmEx • Discovery • COD's • Quantity Pricing

LASER MODULE



Auto Power Control
Collimated Laser
Compact Size
100,000 hr lifetime
No Electronics Required

Visible Laser Modules(635-670 nm)
TTL Modulated Laser Modules
Line Generator Laser Modules
Infrared Laser Modules(780-830 nm)
from $ 29 (US)

LASER POINTER

Focus Adjustable
Elegant Design
Solid Metal Body

Pen Style Laser Pointer (1500 ft visibility)
Key Chain Laser Pointer (1500 ft visibility)
Available in silver and, black finish.
$19.95 (US)

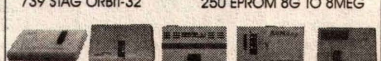
World Star Tech. *Ask for free catalog*
Tel:(416)204 6298 Fax:(416)596 7619
http://www.worldstartech.com e-mail: info@worldstartech.com

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HILO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK

PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SIP TESTER EMUPA

CALL ADVANTECH LABTOOL	599 EETOOLS SIMMAX
629 ICE TECH MICROLV	795 CHROMA SIMM/SIP
650 EETOOLS ALLMAX +	359 MOD-MCT-EMUPA/R
409 EETOOLS MEGAMAX	279 MOD-MCT-EMUP/R
509 EETOOLS MEGAMAX4	49 EPROM 1G TO 512K
369 XELTEK SUPERPRO II	69 EPROM 1G TO 1MEG
409 XELTEK SUPERPRO II P	99 EPROM 4G TO 1MEG
249 XELTEX SUPERPRO L	199 EPROM 16G TO 1 MEG
165 XELTEK ROMMASTER II	89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA	129 EPROM 4G TO 8MEG
739 STAG ORBIT-32	250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

General Device Instruments
Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234
Web www.generaldevice.com E-Mail icdevice@best.com

SURVEILLANCE
The Latest High Tech Professional Electronic Devices

Our latest catalog offers a HUGE selection of surveillance, countersurveillance - privacy devices: ***spy*** **pinhole camera $99.00**, hidden video, ***"realtime"*** **15-Hour telephone recorder $149.00**, 12 hour VOX recorder phone call register, bug detectors, phone tap detectors, voice disguisers, locksmithing tools, wireless video, vehicle tracking via the internet and much more. Wholesale/retail.

We will not be undersold.
Catalog $5.00 *or*
www.spyoutlet.com

SPY OUTLET
PO Box 337, Buffalo NY 14226
(716) 691-3476/(716) 695-8660

EPROM+

A device programming system for design, repair and experimentation

- *EXCEPTIONAL POWER FOR THE PRO*
- *EASY-TO-USE FOR THE NOVICE*
- *INCLUDES STEP-BY-STEP TUTORIAL*

Here's what you get: A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters.* Comprehensive. easy-to-use software which is specifically designed to run under DOS. Windows 3.1. 95 and 98 on any speed machine. The software has features which let you **READ. PROGRAM. COPY** and **COMPARE** plus much more. You have full access to your system's disk including **LOADING** and **SAVING** chip data plus automatic processing of **INTEL HEX. MOTOROLA S-RECORD** and **BINARY** files. For detailed work the system software provides a full screen **buffer editor** including a comprehensive **bit and byte tool kit** with more than 20 functions.

Broad device support: **FIRST GENERATION EPROMS** (2708. TMS2716*. 25XX) **SECOND GENERATION EPROMS** (2716-28C080). **40 AND 42 PIN EPROMS*** (27C1024-27C160) **FLASH EPROMS** (28F.29C.29EE.29F). **EEPROMS** (2816-28C010). **NVRAMS** (12XX.X2210/12) **8 PIN SERIAL EEPROMS*** (24. 25. 85. 93. 95. 80011A) PLUS **ER1400/M58657*** AND **ER5901** **BIPOLAR PROMS*** (72S/82S). **FPGA CONFIGURATORS** (17CXXX) **MICROCONTROLLERS*** (874X. 875X. 87C5XX. 87C75X. 89C5X) **ATMEL MICROS*** (8-40) PIN 89CX051. 89SXXXX (**AVR**) 90SXXXX **PIC MICROS*** 8. 18. 28. 40 PIN (12CXXX-16CXXX. 16FXX. 17C) **MOTOROLA MICROS*** (68705P3/U3/R3. 68HC705, 68HC711)

$289

*REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUILD YOURSELF) **$5.00 SHIPPING • $5.00 C.O.D.**

1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE **VISA•MASTERCARD•AMEX**

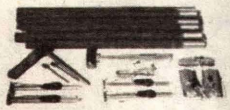
ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150
(513) 831-9708 FAX (513) 831-7562 website - www.arlabs.com

ELECTRONIC MILITARY SURPLUS

FAIR RADIO SALES

WEBSITE: fairradio.com
E-MAIL: fairadio@wcoil.com
PHONE: 419-227-6573
FAX: 419-227-1313
1016 E. Eureka - Box 1105
Lima, OH 45802
VISA, MASTERCARD, DISCOVER
Address Dept. ES

30 FT MAST KIT



AB-1244/GRC MAST KIT, 12 aluminum alloy on steel sections form sturdy, lightweight 30 ft 1.7" dia mast. Kit includes 5 each lower and upper sections, 1 ea lower and upper adapter sections, gin pole swivel base, 4 ea 36 and 42 ft guy ropes, 4 guy stakes, 2 guy rings plus 2.5 pound sledge hammer. Part of OE-254/GRC antenna set; 30 lb sh. New, $139.50 plus shpg.

SEND FOR OUR NEW 1999 CATALOG

Radios - Test Equipment - Tubes - Antennas

1-800-USA-NAVY.

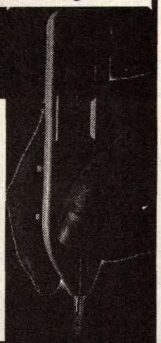
World Wide Web:
http://www.navyjobs.com

Turn your PC into a 16-bit Storage Scope spectrum analyzer, and digital multimeter!

ADC216 turns your PC or laptop into a sophisticated storage scope AND spectrum analyzer AND multimeter. Display on large screen! Print in color! 100MS/s 8-bit, 1.2MS/s 12-bit or 333kS/s 16-bit versions. Great for test depts, schools. Input to Excel. LabView/NT drivers. Get very high precision without high cost!

osziFOX

handheld 20MS/s Storage Scope



oszifOX is a sophisticated digital storage scope packed into a handy, slim penlike housing. Despite its small size, **osziFOX** can perform like a service scope with a 20MS/ssampling rate so signals in microprocessor or audio circuits can be measured easily. A built-in backlit LCD shows the waveforms but the recorded signals can also be sent to a PC via a serial interface. Runs from 9V battery or external source. Auto, internal and external triggers. AC/DC voltameter function too. Only **$129!**

also .....

RS232-422/485 converters, self-powered, opto-isolated
I2C adapter boards for PC communication with I2C bus
mini dataloggers for events, voltages, pressures, etc.
Enviromon temperature and environment netwk logger
thermocouple and **thermistor** adapters for PC ports.
BASIC-programmable **BASIC-TIGER** controller modules
PCI framegrabbers - switch between 2 inputs locked!
lowcost **A/D adapters** turn your PC into a display scope

Saelig Company
www.saelig.com saelig@aol.com
716-425-3753 • 716-425-3835 (fax)

1-888-7SAELIG

Weeder Technologies

VISA

Visit our **ON-LINE CATALOG**

MasterCard

Pro-Kit

PO Box 2426, Ft. Walton Beach, FL 32549 **www.weedtech.com** **Voice/Fax 850-863-5723**

Stackable RS-232 Kits

Digital I/O - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 192 I/O points. Turn on/off relays. Sense switch transistions, button presses, 4x4 matrix decoding using auto-debounce and repeat. **$32**

Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **$49**

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive and transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. **$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ascii character string. Example: *12/31 08:45 850-863-5723 Weeder, Terry <CR>*. Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **$35**

Touch-Tone Input - Decodes DTMF tones used to dial telephones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation or Digital I/O kits using a remote telephone. **$34**

Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have *not* been entered.

Block out selected outgoing calls. Bypass at any time using your password. **$35**

Block out selected incoming calls. Calls identified using Caller ID data. **$48**

Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands. Monitor room noises with built in mic. "Dial-Out" pin instructs unit to pick up phone and dial user entered number(s). Password protected. **$49**

IR Remote Control Receiver

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **$32**

DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **$55**

ALL ELECTRONICS CORPORATION

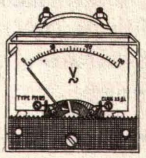
QUALITY PARTS

FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX or E-MAIL For A Free 96 Page CATALOG.
Outside the U.S.A. send $3.00 postage.

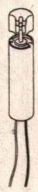
PM89 SERIES PANEL METERS



3.15" x 2.5" x 2" depth.
2.5% accuracy.
Large clear scale, black lettering on white background. Available in a variety of ranges.

DC AMMETERS	CAT #	EACH	10+
0-100 mA DC	PMD-100MA	$12.00	$10.00
0-1A DC	PMD-1A	$12.00	$10.00
0-5A DC	PMD-5A	$12.00	$10.00
0-15A DC	PMD-15A	$12.00	$10.00
DC VOLTS	**CAT #**	**EACH**	**10+**
0-15V DC	PMD-15V	$12.00	$10.00
0-30V DC	PMD-30V	$12.00	$10.00
AC AMMETERS	**CAT #**	**EACH**	**10+**
0-5A AC	PMA-5A	$12.00	$10.00
0-15A AC	PMA-15A	$12.00	$10.00
AC VOLTMETERS	**CAT #**	**EACH**	**10+**
0-150V AC	PMA-150V	$12.00	$10.00
0-300V AC	PMA-300V	$12.00	$10.00

1.5 Volt Mini-Vibrating Motor

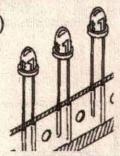


Tiny 1.5 Volt motor with offset-weighted shaft. Typically found in pocket pagers and cell phones for vibrating alert signal. Operates on 1.5 Volts, 80 mA. Motor body is 0.28" dia. x 0.67" long. Shaft is 0.03" (1mm) dia. x 0.16" long.

CAT# DCM-131 **$2.50 each**

10 for $22.50 • 100 for $200.00
500 for $875.00 ($1.75 each)

3000 MCD ULTRA-BRIGHT RED LED



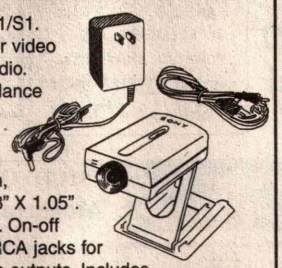
Everlight # 383URC-2/TR1-C(R) Red, "Ultra-bright" T 1 3/4 LEDs "Tape-and-reel" parts. These are 5 mm diameter water-clear LEDs that light bright red at 20 mA.

CAT# LED-50

2 for $1.00

100 for $35.00
1000 for $250.00

INCREDIBLY LOW PRICE! Sony Color Video Camera with Audio

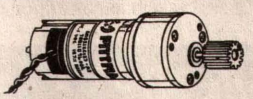


Sony# CCX-Z11/S1. Brand new color video camera with audio. Ideal for surveillance or video conferencing. Good-looking, compact design, only 3.5" X 2.33" X 1.05". Adjustable lens. On-off power switch. RCA jacks for video and audio outputs. Includes 4.5 Vdc power supply, output cables and adjustable desktop camera stand which can easily be used as a wall or ceiling mount bracket. Get one now...at this price they won't last.

CAT# VC-1100 **$90.00 each**

3 or more $85.00 each

40 RPM Gearhead Motor

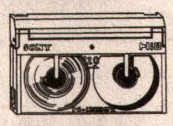


Pittman # GM8212C127-R2. Small, powerful gearhead motor. 187:1 ratio. No load specs: 40 RPM @ 19.1 Vdc, 130 mA. 24 RPM @ 12 Vdc, 160 mA. Overall dimensions 3" long X 1.37" diameter. 0.185" (3/16") diameter X 0.75" long shaft. A brass 0.56" diameter gear with 16 cogs is fastened to the shaft, 17" leads.

CAT# DCM-135 **$15.00 each**

10 for $125.00

"HI-8" Video Cassette

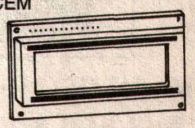


SONY Hi-8 Top quality, metal particle 120 minute video cassettes. *Used for a short time, then bulk-erased.* Each cassette has its own plastic storage box.

CAT # VCU-8 **$3.00 each**

10 for $28.00 • 100 for $250.00

20 Character X 4 Line LCD



Optrex # DMC 20434-CEM (PWB 20434-CEM)
5 x 8 dot format.
3" x 1" viewing area.
3.88" x 2.38" module.
Removed from new equipment. May have felt padding on metal bezel. 14 pin single row header is pre-attached. Spec/hook-up sheet included.

CAT# LCD-46 **$7.00 each**

10 for $60.00

AIWA "Surround" Bookshelf Speakers

AIWA# SX-ANA72. Great sounding, great-looking set of AIWA "Front 180" bookshelf speakers with a unique "expanded imaging" feature. Uses an array of speakers and ports to project the sound forward and toward the center at a 45 degree angle to create an expanded stereo listening area and the impression of a "center-channel." Each speaker has two channels with two separate input cables. The AIWA stereo system for which they were designed had separate outputs for the center-projecting part of each speaker, but the center-angled speakers sound good when connected in parallel with the front-facing channel. Titan silver and charcoal. Removable front grills. 9.75" wide X 11" deep X 12.25" high.

CAT # SK-72 **$49.95 per pair**

Small Irregular Neodymium

Small arc shaped neodymium magnets with a shiny finish. Sizes vary. The smallest are 0.39" long x 0.15" x 0.085" thick. Some are slightly larger.

CAT# MAG-49 **4 for $1.00**

100 for $17.00

ORDER TOLL FREE 1-800-826-5432

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
www.allelectronics.com
E-MAIL allcorp@allcorp.com

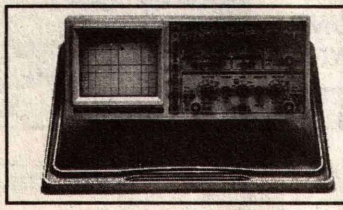
NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D • Shipping and Handling $5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

CIRCLE 214 ON FREE INFORMATION CARD

New and Pre-Owned Test Equipment

Goldstar



Model OS-5100 → $899.00

Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

Spectrum Analyzer
Avcom PSA-37D

Satellite Downlink
Installation
Maintenance & Service

- Band 1 10 – 1750 MHz
- Band 2 3.7 – 4.2 GHz
- Built-in DC Block & Power for LNA/LNB's
- Line or Battery Powered

Only $2,475.00!

Pre-Owned Oscilloscope Specials

Tektronix 2213	60 MHz	$549.00
Tektronix 2215	60 MHz	$649.00
Tektronix 465	100 MHz	$599.00
Tektronix 465B	100 MHz	$729.00
Tektronix 475	200 MHz	$829.00
Tektronix 475A	250 MHz	$999.00

- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- The Industry Standard of Oscilloscopes
- **1 Year Warranty** - The Longest Available!!!

We Buy Surplus Test Equipment

Leader CATV Signal Level Meter Model LF 941
✓TV/CATV Coverage from 46 - 870 MHz
✓Video/Audio Carrier Measurements $695.00!

Just Released! → "Series III" Multimeters
Fluke Model 87III $319.00 !!!

SIMCHECK®II PLUS
Module Tester
* Tests SIMMs/168 p DIMMs
* Stand alone/portable
* Identifies Module properties
* Advanced Setup Capabilities
Only $2750.00!

See us on the Web!
www.fotronic.com

Test Equipment Depot
A FOTRONIC CORPORATION COMPANY
99 Washington St. Melrose, MA 02176
(781) 665-1400 • FAX (781) 665-0780
email: sales@fotronic.com

VISA MasterCard AMEX C.O.D.

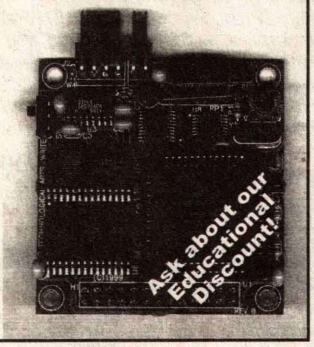
TOLL FREE 1-800-99-METER
(1-800-996-3837)

CIRCLE 333 ON FREE INFORMATION CARD

Building a Micro Robot ?

MicroCore-11™
- tiny 2" x 2" stackable 68HC11 microcontroller module
- plugs into solderless breadboard like a chip
- download programs via you PC serial port
- use assembler or BASIC (both included)
- 32K SRAM plus 8K or 32K EEPROM
- RS232, 5V regulator, 8MHz xtal

8K Starter Package #MC11SP8K.....US$75.00
32K Starter Package #MC11SP32K.....US$89.00
Motor driver board and accessories available.



Technological Arts

26 Scollard Street
Toronto, Ontario
Canada M5R 1E9
Phone: (416) 963-8996
Fax: (416) 963-9179

www.technologicalarts.com

CABLE TV BOXES

Hablamos Español!!
We'll Beat Any Price!

30 Day Trial • 1yr. Wrnty • Free Catalog •
Qty. Discounts • Dealers Welcome!

1-800-538-2225

Galaxy Electronics Inc.
Www.Galaxydescramblers.com

Cable T.V.
Converters & Equipment

Lower Prices
Dealer Discounts
30-Day Money back
1-year warranty
MC, Visa, AE, COD

Pro Planet

No Florida Sales

www.cable4you.com

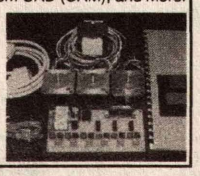
1-(800) 888-5585

3 Axis Motion Control System
Complete, ready to run

$ 295.00 + 12.00 S/H

Build or adapt CNC mills, CNC routers, Robots, Etc. Includes: 3 Stepping motors (70 oz/in 200 steps/rev). External board (connects to parallel port of a PC). Power supply. Cables, Manual and the MAXNC drive software, with linear, circular and helical interpolation, acceleration deceleration, full contouring, 'G' code programming, screen plot, code generation from CAD (CAM), and more.

For more information, phone or write to:
MAXNC
6730 West Chicago
Suites 2 & 3
Chandler, AZ 85226
Ph (602) 940-9414
Fax (602) 940-2384



GREAT FOR TEST FIXTURE BUILDING

FREE!
PHONE, FAX, WRITE OR E-MAIL WITH YOUR MAILING ADDRESS
MUST MENTION OFFER "LAB199"

PRE-PUNCHED END PANELS ALSO AVAILABLE
9 BOX SIZES
25 PREPUNCHED END PANELS

LAB-1
(1.5" x 2.0" x 0.75")

ALSO IN STOCK AT:
JENSEN TOOLS: 800-426-1194
MCM ELECTRONICS: 800-543-4330
TECH AMERICA: 800-442-7271

ALL ALUMINUM CONSTRUCTION **LOW COST**
OFFER GOOD ONLY IN THE 48 STATES. ENDS DECEMBER 20, 1999. LIMIT ONE REQUEST PER CUSTOMER. MAILED 1ST CLASS, ALLOW 1-2 WEEKS FOR DELIVERY

SESCOM®

ORDERS 800-634-3457 • FAX 800-551-2749
OFFICE 702-565-3400 • FAX 702-565-4828
www.sescom.com • info@sescom.com
SESCOM, INC. 2100 WARD DR., HENDERSON, NV 89015
SESCOM, INC. is not responsible for inadvertent typographical errors and prices and specifications are subject to change without notice.

Order On-Line for 5% Discount

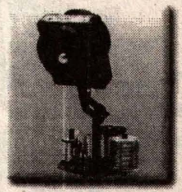
from our already LOW PRICES

EDSYN 951SX
Soldering Station

CHIP QUIK SMD1
Low Temp. Desoldering

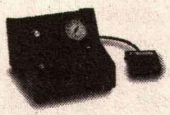
Stereo Zoom
Microscopes

3GHz RF Probe

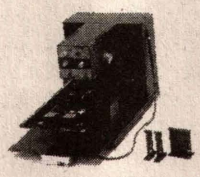


EDSYN FXF11
Fume Extractor Fan

Capacitor Wizard
ESR Meter



Kahnetics Solder
Paste Dispenser



DEN-ON SD3000
SMD Rework Station

971HA SMD
Hot Air Station

EDSYN ZD500DX
Desoldering Station

www.howardelectronics.com

This is all you need to know for your soldering and desoldering needs for the Professional Technician, Engineer, Manufacturer or Experimenter.

Features

* **On-Line Shopping Cart**
* **Totally Secure web Server**
* **Automatic 5% discount from our already low prices.**
* **Payment Options to Fit Your Needs**

1. Credit Card Authorization
2. COD Company Check
3. Add to Open Account
4. Open Account for First Time
5. Will Send Check
6. Wire Transfer to our Bank

Benefits

* **Order any time (24 hrs. a day – 7 days a week)**
* **Order at your Convenience**
* **Check out various Soldering & Desoldering Tool Specifications**
* **See Large Screen Size Pictures at fast down-load times**
* **Order Tips, Filters, accessories and Parts On-Line**
* **Catch our Monthly Specials On-Line**

DEN-ON SC7000Z
Desoldering Tool

order FREE TRIALS on-line

If you are not yet On-Line, Call
Toll Free 1-800-394-1984
01-316-744-1993 International
1-316-744-1994 Fax
6222 N. Oliver Kechi, KS 67067

CIRCLE 331 ON FREE INFORMATION CARD

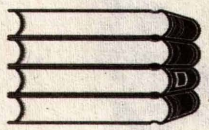
ELECTRONIC TECHNOLOGY TODAY INC.

P.O. Box 240 • Massapequa Park, NY 11762

INVENTORY BLOWOUT SALE

30% OFF

FREE GIFT
With any order over $15
(while supplies last)



*** ALL CANADIAN CHECKS MUST CLEAR THROUGH AN AMERICAN BANK**

BP07	100 Radio Hookups	$3.00	
BP37	50 Projects Using Relays, SCR's and Triacs	$3.99	
BP48	Electronic Projects for Beginners	$2.99	
BP56	Electronic Security Devices	$3.99	
BP64	Semiconductor Technology Elements of Elect Book 3	$5.99	
BP74	Electronic Music Projects	$3.99	
BP76	Power Supply Projects	$3.99	
BP78	Practical Computer Experiments	$2.99	
BP88	How to Use OP Amps	$5.99	
BP93	Electronic Timer Projects	$2.99	
BP103	Multi-Circuit Board Projects	$2.99	
BP112	A Z-80 Workshop Manual	$5.99	
BP114	The Art of Programming the 16K ZX81	$3.99	
BP115	The Pre-Computer Book	$2.99	
BP124	Easy Add-On Projects for the Spectrum, ZX81 & ACE	$3.99	
BP148	Computer Terminology Explained	$2.99	
BP154	An Introduction to MSX Basic	$3.99	
BP156	An Introduction to QL Machine Code	$3.99	
BP187	A Prac Ref Guide to Word Pro Amstrad PCW8256/PCW8512	$7.99	
BP190	More Advanced Electronic Security Projects	$3.99	
BP194	Modern OPTO Device Projects	$3.99	
BP232	A Concise Introduction to MS-DOS	$3.99	
BP245	Digital Audio Projects	$3.99	
BP248	Test Equipment Construction	$3.99	
BP256	An Intro to Loudspeakers and Enclosure Design	$3.99	
BP264	A Concise Advanced User's Guide to MS-DOS	$3.99	
BP267	How to Use Oscilloscopes and Other Test Equipment	$5.99	
BP272	Interfacing PCS and Compatibles	$5.99	
BP290	An Intro to Amateur Communications Satellites	$5.99	
BP297	Loudspeakers for Musicians	$6.99	
BP299	Practical Electronic Filters	$6.99	
BP304	Projects for Radio Amateurs and S.W.L.S	$5.99	
BP317	Practical Electronic Timing	$6.99	
BP320	Electronic Projects for Your PC	$5.99	
BP321	Circuit Source Book 1	$6.99	
BP322	Circuit Source Book 2	$6.99	
BP329	Electronic Music Learning Projects	$6.99	
BP332	A Beginners Guide to TTL Digital ICS	$6.99	
BP333	A Beginners Guide to CMOS Digital ICS	$6.99	
BP334	Magic Electronic Projects	$6.99	
BP355	A Guide to the World's Radio Stations	$7.99	
BP359	An Introduction to Light in Electronics	$6.99	
BP367	Electronic Projects for the Garden	$6.99	
BP370	The Superhet Radio Handbook	$6.99	
BP371	Electronic Projects for Experimenters	$6.99	
BP374	Practical Fibre-Optic Projects	$6.99	
BP378	45 Simple Electronic Terminal Block Projects	$6.99	
BP379	30 Simple IC Terminal Block Projects	$6.99	
BP384	Practical Electronic Model Railways Projects	$6.99	
BP391	Fault-Finding Electronic Projects	$6.99	
BP392	Electronic Project Building for Beginners	$6.99	
BP393	Practical Oscillator	$6.99	
BP394	An Introduction to PIC Microcontrollrs	$7.99	
BP396	Electronic Hobbyists Data Book	$7.99	
BP401	Transistor Data Tables	$7.99	
BP411	A Practical Intro to Surface Mount Devices	$6.99	
BP413	Practical Remote Control Projects	$7.99	
PCP107	Digital Logic Gates and Flip-Flops	$10.99	
PCP112	Digital Electronics Projects for Beginners	$10.99	
PCP114	Advanced MIDI Users Guide	$10.99	
ETT1	Wireless & Electrical Cyclopedia	$4.99	

PRICES DO NOT INCLUDE SHIPPING & HANDLING. ALL SALES ARE FINAL, NO RETURNS

ORDER FORM

Book No.	Title	Price	No. of Copies	Cost

SHIPPING COSTS			
$0.01 to $5.00	$2.00	$20.01 to $30.00	$5.00
$5.01 to $10.00	$3.00	$30.01 to $40.00	$6.00
$10.01 to $20.00	$4.00	$40.01 to $50.00	$7.00
$50.01 and above	$8.50		

Total Amount $	
- 30% off	
Subtotal	
Add shipping cost (see table)	
Local NY State Sales Tax	
TOTAL COST $	

Name _____

Address _____

City _____ State _____ Zip _____

If you wish to use a Credit Card:

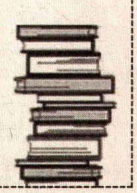
☐ MasterCard ☐ Visa Expire Date /

Card No. _____

Signature _____

Allow 6-8 weeks for order to be fulfilled.

Please return this order form to:
ELECTRONIC TECHNOLOGY TODAY, INC.
P.O. Box 240
Massapequa Park, NY 11762-0240



Telephone Orders: If you wish to place your credit-card order by phone, call 516/293-0467. Automated order taking system functions 24 hours a day. Have your credit-card ready. Sorry, no orders accepted outside of U.S.A. and Canada, New York State Residents must add applicable sales tax. Offer expires 12/31/99. ET11

2539 W. 237th Street, Bldg. F, Torrance, CA 90505
Order desk only: USA: (800) 872-8878 CA: (800) 223-9977
L.A. & Technical Info: (310) 784-5488 Fax: (310) 784-7590
OEM INQUIRIES WELCOME

TIMELINE INC.

Over 14 years and 31,000 customers and still growing

Minimum Order: $20.00. Minimum shipping and handling charge $5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

Liquid Crystal Displays

240x64 dot LCD with built-in controller.

AND 4021ST-EO. *Unit is EL back-lit.* $59.00 or 2 for $109.00 *or*
OPTREX. DMF5005 *(non back-lit)* $49.00 or 2 for $89.00

20 character x 8 line 7¾L x 2½H — *The built-in controller allows you to do text and graphics.*

Alphanumeric—parallel interface

16x1	$7.00	20x2	$10.00	32x2	$8.00
16x1 (lg. char.)	$10.00	20x4	$15.00	40x1	$8.00
16x2	$7.00	20x4 (lg. char.)	$10.00	40x2	2 for $20.00
16x2 (lg. char.)	$10.00	24x2	$10.00	40x4	$20.00
16x4	$15.00	32x4	$10.00	4x2	$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • ***Certain models are backlit, call for more info.***

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	$25.00	480x128	Hitachi	$10.00
640x400 (backlit)	Panasonic	$20.00	256x128	Epson	$20.00
640x200	Toshiba	$15.00	240x128 (backlit)	Optrex	$20.00
480x128 (backlit)	ALPS	$10.00	240x64	Epson	$15.00
			160x128	Optrex	$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 **$25.00**

Monitors

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15Khz. • Ability to do 40 and 80 column.
5 inch Amber $25.00 • 7 inch Amber $25.00
9 inch Amber or Green $25.00

5" COLOR MONITOR $39.00

2 for $69.00

• Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
• 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
• Open Frame Construction • Standard Interface Connector • Degaussing Coil included • *Mfr. Samtron*

9" COLOR SVGA MONITOR $179.00 Fully Enclosed – Tilt and swivel type.

Pos & Bar Code

MAGNETIC CARD READER $25.00

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypanel with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.
HP bar code wand (HBCS 2300) $19.00

Hacker Corner

Embedded 486 Computer $99.00

Complete enhanced Intel 486SX-33 based computer in ultra small (9-7/8L x 6-5/8W x 3-1/8H) case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

SONY Miniature Color LCD Display (LCX005BKB) $29.00

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

CELL SITE TRANSCEIVER $49.00 2 for $89.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 HMz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

4 INCH LCD MONITOR $49.00

Compact (4.4" x 3.8" x 1.4") TFT active matrix LCD color monitor including fluorescent backlight. Analog RGB and composite sync input with switchable horizontal / vertical viewing. Low power consumption and long life backlight make it ideal for security and door phone use. Single 8 VDC supply and good resolution allow mobile operations or use with laptops. Standard ribbon cable - Molex connector interface. Complete specifications included.

NTSC COMPOSITE 4" LCD MONITOR $69.00

CIRCLE 275 ON FREE INFORMATION CARD

DATA ACQUISITION & CONTROL

AFFORDABLE PLUG-IN BOARDS FOR PC's ISA BUS

ANA100 Analog I/O ..... $ 99

* 8 Channel 8-Bit
* 0 to 5 Volt Input
* 14 TTL I/O lines
* Analog Output
* 400KHz Sampling

DIG100 Digital I/O ..... $ 39

* 82C55 PPI
* 24 or 48 TTL I/O Lines option
* Selectable Base Address

ANA150 Analog/Counter... $ 89

* 8 Channel 8-Bit 0 to 5 Volt Input
* 3 16-Bit Counters
* 400KHz Sampling

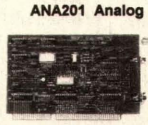
DIG200 Counter I/O ..... $ 79

* 3 16-Bit Counters
* 8 TTL Input lines
* 8 TTL Output lines
* Selectable Clock Frequency Input

ANA200 Analog I/O ..... $ 79

* 1 Channel 12-Bit 0 to 5 Volt input optional bi-polar
* 100KHz / 300KHz Sampling rate
* 24 TTL I/O lines

ANA201 Analog ..... $ 119



* 8 Channel 12-Bit
* x1, x5, x10, x50 Programmable Channel gain
* 100KHz Sampling rate

On-Line Product Catalog at Our Web Site
http://www.Bsof.com
E-Mail: Sales@Bsof.com

BSOFT Software, Inc.

444 COLTON ROAD * COLUMBUS, OH 43207
PHONE 614-491-0832 * FAX 614-497-9971

PIC'n Books

LEARN ABOUT PIC MICROCONTROLLERS

EASY PIC'n - Beginner $29.95

PIC'n Up The Pace - Intermediate $34.95

NEW!

PIC'n Techniques - Intermediate $34.95

- 8-pin PICs
- Timer 1, timer 2 and the capture/compare/PWM (CCP) module
- Talking to a PIC with a PC using a terminal program
- Test equipment and data logger experiments

See Table Of Contents: http://www.sq-1.com
Secure Online Ordering Is Available

+ $4 s/h in US for 1 book, $5 for 2 books, $6 for 3 books
VISA, MC, AMEX, MO, Check
CA residents please add 7.25% CA sales tax
PIC and MPLAB are trademarks of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
Web Site: http://www.sq-1.com
E-Mail sqone@pacific.net

CLASSIFIED

BUSINESS OPPORTUNITIES

$400 Weekly Assembling electronic circuit boards/products from home. For FREE information send SASE: **Home Assembly-EN** Box 216 New Britain, CT. 06050-0216

Have an idea? If so, we are a national company working with ideas, inventions, new products. Patent services. Call 1-888-439-IDEA.

FREE MONEY! NEVER REPAY. GUARANTEED. BUSINESS START, EXPANSION, PERSONAL NEEDS, DEBT CONSOLIDATION. FREE PACKAGE 1-888-290-5605

FREE DEBT RELIEF! Not a loan. Not bankruptcy. Lower payments and interest instantly. Private. Call **AMERIX** NOW. **1-800-570-3021 (code 4299).**

CABLE TV

Cable TV descramblers. One-piece units. Scientific Atlanta, Jerrold, Pioneer, and others. Lowest prices around. **Precision Electronics,** Houston, TX anytime.1-888-691-4610.

Descramblers, Converters, Activators, Rft's, Ftg's, Bullet Snoopers, All Options Explained, Best Prices, Services, 2yr. Warranty, Free Catalog 1-800-854-1674 www.resourceleader.com

CABLE DESCRAMBLER PLANS!!! Plus two free bonuses, Radar Jammer Plans and Cable manual $14.00. 1-888-367-9972

Bewildered about descramblers? Call for your options. Same day shipping M-F, 9-8 Sat 12-5 GLOBAL ELECTRONICS 1-888-221-8365.

WHOLESALE PRICES, SUPERIOR QUALITY, INTERNAL AND EXTERNAL ACTIVATORS. 1ST TIME DISCOUNT. $200.00 min. COD ONLY. 24/7 MESSAGE SERVICE. SALES OPEN M-F 8:00 AM TO 4:30 PM. CALL LUNAR INDUSTRIES 1-800-289-9566.

NEW! Cellphone E.S.N. readers **$250** each, cell phone programmers **$175** each, cell phones **$25** each, DSS satellite dish card readers and programmers **$125** each, credit card readers **$250** each, Cable T.V. notch filters **50 cents** each, converter boxes **$50** each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under **$200** each. You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for **only $59.95 plus $5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.**

New! Jerrold and Pioneer wireless test units $125 each, also 75DB notch filters $19.95 each, quantity pricing available please call **KEN ERNY ELECTRONICS** 24 hour order and information hot line 516-389-3536.

PAY TV AND SATALLITE DESCRAMBLING 2000 EDITION. All new. All the latest satellite fixes, schematics, blockers, activators etc. for cable and satellite $16.95. Complete Pay TV Series (Vol. 1-10) $59.95. Hacking Satellite Systems Videos $29.95. Scrambling News subscription with web access $34.95. Everything listed above $99.95. Choose hard copy or CD-ROM. **SCRAMBLING NEWS,** 4798 South Florida Ave, PMB-108, Lakeland, FL 33813. 941-646-2564.COD's are OK. Add $6.00. Free catalog.

DESCRAMBLER BLOWOUT Scientific Atlanta 8580. Original one piece. 99 channels. Guaranteed. Single $160,—(5) 140,—(10) 120. **NOVICOR ELECTRONICS** 412-833-0773

CABLE DESCRAMBLERS, including activators for all Jerrold Dp5-**CFT 22 xx's** and **SP's.** Lowest single or lot prices. Also, **RFT-Dams** Zenith, **SCIENTIFIC ATLANTA,** and **PIONEER.** Se habla en espanol. **Call 888-684-9277.**

CABLE DESCRAMBLING, New Secret manual. Build your own Descramblers for Cable and Subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, $12.95, $2 postage **CABLETRONICS,** Box 30502R, Bethesda, MD 20824.

CABLE BOXES ALL MODELS, ALL CHANNELS. Lowest prices in the United States. Open seven days a week till midnite, Pacific time. Call (877) 789-7337 Toll-Free.

Descramble Cable with simple circuit added to Radio Shack RF Modulator and using VCR as tuner, instructions $10.00. **TELCOM** Box 832E11 Brushly, LA 70719.

CB-SCANNERS

CB Radio Modifications! Frequencies, kits, high-performance accessories, books, plans, repairs, amps, 10-Meter conversions. The best since 1976! Catalog $3.00. **CBCI** Box 1898 EN, Monterey, CA 93942. www.cbcintl.com

COMPUTER HARDWARE

ROBOT Module. Security Robot Kit. Free Catalog. www.actionrobotics.com **ACTION ROBOTICS** Box 138, Boston, NY 14025

EDUCATION

LEARN ELECTRONICS. HOME STUDY. OUTSTANDING CARRERS. FREE LITERATURE. **P.C.D.I.,** ATLANTA, GEORGIA. CALL 800-362-7070. DEPT. ELM342.

MISC. ELECTRONICS FOR SALE

Acquire, Control, Display! Simple, fast, and fun systems. www.industrologic.com (314) 707-8818.

PLANS-KITS-SCHEMATICS

ELECTRONIC PROJECT KITS:$3.00 catalog. 49 McMichael St. Kingston, ON., K7M 1M8. **www.qkits.com – QUALITY KITS**

AWESOME KITS: Ion Propulsion Motor, Stepper Driver, Solar Robot, Scrolling Clock and more! Catalog $1.00. **LNS Technologies,** PO Box 67243, Scotts Valley, CA 95067 www.techkits.com

HDTV HACKING, unpacking the data stream to decode HDTV, $19.95. **CABLETRONICS,** Box 30502R Bethesda, MD 20824.

LOW-COST 12-BIT A/D KITS. 8 A/D, 2 D/A, current sources and digital I/O for printer port $59. Includes software. 1-channel A/D $39. http://www.tgn.net/~adnav/ or e-mail: adnav@tgn.net.

SATELLITE EQUIPMENT

DSS Test card. Authorizes all channels for information, plus free bonus. Call toll free 1-888-416-7296.

FREE Satellite TV Buyer's Guide. Best Products – Lowest Prices – Fastest Service! Dish Network, DirecTV, C/Ku-band, including 4DTV. Parts – Upgrades – Accessories! **SKYVISION** - 800-543-3025. International 218-739-5231 www.skyvision.com

DSS Hacking: How to construct and program smart cards, with pic 16C84, PCB layout. Complete DSS system schematics, $16.95. Software $25. **CABLETRONICS** Box 30502R Bethesda, MD 20824.

TELEPHONE

SLASH your long distance bill using an amazing new low cost device. FREE information, 24 hours, 800-363-2319.

TEST EQUIPMENT

Test Equipment Sale! Complete listing at http://wwwastglobal.com or call **NOW** to receive list by fax or mail. **AST GLOBAL ELECTRONICS:** Voice 888-216-7159; Fax 814-398-1776; e-mail: sales@ astglobal.com

WANTED

WANTED: USED TEST EQUIPMENT. TURN IDLE OR EXCESS EQUIPMENT INTO CASH. AST GLOBAL ELECTRONICS: Voice 888-216-7159; Fax: 814-398-1176; e-mail: sales@ astglobal.com

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

MONEYMAKING OPPORTUNITIES

MOTHER'S DREAM — WORK FROM HOME — (303) 337-3484, 24 Hours.

FAXALERT! Wealth Opportunities Now! FOD 1-703-904-1818 document 968.

$800 WEEKLY POTENTIAL processing government refunds at home 1-800-696-4779 X2631.

OF INTEREST TO ALL

IS BIG BROTHER WATCHING YOU? Learn how to safeguard privacy, thwart telemarketers, check credit records and more. Free info from: McClellan Publications, PMB 408, 1410 Blalock, Houston, TX 77055.

PicC C Compiler $59

for Microchip's PIC microcontrollers

Supports **PIC16C55x, 16C6x, 16C62x, 16C8x, 16C92x** PIC families

SnXC C Compiler $59

Supports **SceniX sx18ac** and **sx28ac** microcontrollers

Both compilers based on **ANSI C** standard. Arrays, unions, structures, pointers, strings, function calls, if, for, switch, while, interrupt vectors, in-line assembler code, 8 & 16 bit variables, etc. Outputs Intel Hex format and assembly code. Code optimizer included. Excellent development tools!

DebugIDE Debugger $79

C source level debugger for PicC and SnXC compilers. Integrated Development Environment. Step, Run, Stop, Reset. Variable monitoring and modification. Oscillator/cable kit ($39)

732-873-1519 fax: **732-873-1582** e: **grichrc@aol.com**

Grich RC Inc.120 Cedar Grove Ln, Ste 340, Somerset NJ USA 08873

URL: http://members.aol.com/piccompile

BUY BONDS

USE ELECTRONICS NOW CLASSIFIEDS

READ BY ELECTRONIC BUYERS AND SELLERS AND TRADERS

INSTRUCTIONS FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $2.50 per word. Minimum charge is $37.50 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues.**Boldface (not available as all caps),** add .40 per word additional. **Entire ad in boldface,** add 20%. **Tint screen behind entire ad,** add 25%. **Tint screen plus all boldface ad,** add 45%. **Expanded type ad,** add $4.00 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. ELECTRONICS NOW is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

CONTENT

All classified advertising in ELECTRONICS NOW is limited to electronics items only. All ads are subject to the publishers' approval. WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.

AD RATES: $2.50 per word, Minimum $37.50

Send you ad payments to:
ELECTRONICS NOW 500 Bi-County Blvd, Farmingdale, NY 11735-3931

CATEGORIES

100 -- Antique Electronics	270 -- Computer Equipment Wanted	450 -- Ham Gear Wanted	630 -- Repairs-Services
130 -- Audio-Video Lasers	300 -- Computer Hardware	480 -- Miscellaneous Electronics For Sale	660 -- Satellite Equipment
160 -- Business Opportunities	330 -- Computer Software	510 -- Miscellaneous Electronics Wanted	690 -- Security
190 -- Cable TV	360 -- Education	540 -- Music & Accessories	710 -- Telephone
210 -- CB-Scanners	390 -- FAX	570 -- Plans-Kits-Schematics	720 -- Test Equipment
240 -- Components	420 -- Ham Gear For Sale	600 -- Publications	730 -- Wanted

CLASSIFIED AD COPY ORDER FORM

Place this ad in Category #_____ **Special Category $30.00 Additional** _____

1 - $37.50	2 - $37.50	3 - $37.50	4 - $37.50	29 - $72.50	30 - $75.00	31 - $77.50	32 - $80.00
5 - $37.50	6 - $37.50	7 - $37.50	8 - $37.50	33 - $82.50	34 - $85.00	35 - $87.50	36 - $90.00
9 - $37.50	10 - $37.50	11 - $37.50	12 - $37.50	37 - $92.50	38 - $95.00	39 - $97.50	40- $100.00
13 - $37.50	14 - $37.50	15 - $37.50	16 - $40.00				
17 - $42.50	18 - $45.00	19 - $ 47.50	20 - $50.00				
21 - $52.50	22 - $55.00	23 - $57.50	24 - $60.00				
25 - $ 62.50	26 - $65.00	27 - $67.50	28 - $70.00				

Total words _____ $2.50 per word = $_____

Bold Face _____ $0.40 per word = $_____

Special Heading _____ $30.00 = $_____

Other _____ = $_____

Total classified ad payment $_____ **enclosed**

TOTAL COST OF AD $ _____

[ ] Check [ ] Mastercard [ ] Visa [ ] Discover Card # _____ Expiration Date __/__

Signature_____

Name _____ Phone _____

Address_____City State Zip _____

RETAILERS THAT SELL OUR MAGAZINE EVERY MONTH

Arizona

Circuit Specialists, Inc.
220 S. Country Club Dr.
Bldg 2
Mesa, AZ 85210

California

All Electronics
14928 Oxnard Street
Van Nuys, CA 91411

California Electronics
221 N. Johnson Ave.
El Cajon, CA 90202

Electronics Plus, Inc.
823-4th Street
San Rafael, CA 94901

Electronics Warehouse
2691 Main Street
Riverside, CA 92501

Ford Electronics
8431 Commonwealth Ave
Buena Park, CA 90621

HSC Electronics
6819 S. Redwood Drive
Cotati, CA 94931

HSC Electronics
4837 Amber Lane
Sacramento, CA 95841

Halted Specialties Co.
3500 Ryder Street
Santa Clara, CA 95051

Inland Electronic Suppliers
1012 N. Carpenter Rd.
Modesto, CA 95351

JK Electronics
6395 Westminster Blvd.
Westminster, CA 92683

Metro Electronics
1831 J Street
Sacramento, CA 95814

Minute Man Electronics
37111 Post St., Suite 1
Fremont, CA 94536

Orvac Electronics
1645 E Orangethorpe Ave.
Fullerton, CA 92631

San Mateo Elec. Supply
16 W. 42nd Ave.
San Mateo, CA 94403

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove, CA 92643

Whitcomm Electronics
105 W. Dakota 106
Clovis, CA 93612

Colorado

Centennial Electronics
2324 E. Bijou
Colorado Sps., CO 80909

Connecticut

Cables & Connectors
2198 Berlin Turnpike
Newington, CT 06111

Electronic Service Prod.
437 Washington Avenue
North Haven, CT 06473

Delaware

Wholesale Electronics
77 McCullough Dr. Ste. 10
New Castle, DE 19720

Illinois

BB&W Inc.
2137 S. Euclid Ave.
Berwyn, IL 60402

Tri State Elex
200 W. Northwest Hwy.
Mt. Prospect, IL 60056

Indiana

ACRO Electronics Corp.
1101 W. Chicago Ave.
East Chicago, IN 46312

King of the Road Elec.
409 E. Center Rd.
Kokomo, IN 46902

Maryland

Mark Elec. Supply Inc.
11215 Old Baltimore Pike
Beltsville, MD 20705

Massachusetts

Electronic Hook-Up
104 Main St.
Milford, MA 01757

U-Do-It Electronics
40 Franklin Street
Needham, MA 02194

Michigan

Computers Galore and More
3510 N. Elm St. #283688
Jackson, MI 49201

Norwest Electronics
33760 Plymouth Rd.
Livonia, MI 48150

Purchase Radio Supply
327 East Hoover Avenue
Ann Arbor, MI 48104

The Elec. Connection
37387 Ford Road
Westland, MI 48185

Minnesota

Acme Electronics
224 Washington Avenue N.
Minneapolis, MN 55401

Missouri

Gateway Electronics
8123-25 Page Blvd.
St. Louis, MO 63130

New Jersey

Lashen Electronics Inc.
21 Broadway
Denville, NJ 07834

New York

LNL Distributing Corp.
235 Robbins Lane
Syosset, NY 11791

Unicorn Electronics
Valley Plaza
Johnson City, NY 13790

Ohio

Philcap Electronic Suppliers
275 E. Market Street
Akron, OH 44308

Oregon

Norvac Electronics
7940 SW Nimbus Avenue
Beaverton, OR 97005

Texas

Computers Electronics Etc.
110 E. Medical Center Blvd.
Webster, TX 77598

Electronic Parts Outlet
3753 B Fondren
Houston, TX 77063

Tanner Electronics
1301 W Beltine
Carrollton, TX 75006

If you'd like to sell our magazine in your store, please circle 210 on free information card
or
Contact Christina Estrada at (516) 293-3000 ext 223

FREQUENCY PROBE

Build this simple analog instrument to test the frequency of almost any type of waveform

SKIP CAMPISI

Have you ever wanted to make a quick check on the operating frequency of a circuit but realized that it wasn't worth the effort to set up your multi-function frequency counter? Perhaps your counter can only handle 5-volt logic or small-signal RF waveforms, but nothing in between.

If you often find yourself in that situation, the Frequency Probe presented here is just the tool that you're looking for. This instrument is a handheld device that is powered by a single 9-volt battery and uses an analog meter as the display. Of course, you won't get the resolution of a digital display, but accuracy is better than 5%; more than enough in most situations. As a bonus, it is very economical and can be assembled for about $30.

This self-contained unit can measure the frequency of any type of waveform from about DC to beyond 2 MHz as long as the input waveform crosses the input threshold voltage (about 1.0 volt). The maximum swing on the input signal is 30 volts. Any waveform shape within that range can be read—including standard logic level signals.

The Frequency Probe has six basic ranges: 50 Hz, 500 Hz, 5000 Hz, 50 kHz, 500 kHz, and 5000 kHz. Small toggle switches are used to select the range; there is simply no room for rotary switches in a probe design of this type. The unit is constructed with standard, off-the-shelf components, available from many different sources such as Radio-Shack, Tech America, or Mouser Electronics, to name a few.

About the Circuit. Looking at the Frequency Probe's schematic diagram, shown in Fig. 1, note that only four ICs and a handful of passive components are used. Power from a standard 9-volt battery is regulated to 5 volts by IC2. The total current drain is about 10 to 15 mA.

An input signal applied to J1 is converted to a squarewave by IC1. Diodes D1 and D2 set the 1.0-volt threshold; D2 also provides reverse-voltage protection. A few millivolts of hysteresis provided by R2 helps yield a stable output from signals with a slow rise time such as ramps or sinewaves. Note that the specifications for the LM311 being used allow its inputs to swing above the power-supply voltage (up to 30 volts above ground) without damage to the device. That might not be true for devices made by manufacturers other than National Semiconductor—check before substituting a compatible part from another vendor.

The "heart" of the Frequency Probe is IC4, an LM2917N tachometer chip; it converts any input frequency to an output voltage. Because IC4 has its own built-in hysteresis "flip-flop" circuit, waveforms that are more or less symmetrical are best. Pulse inputs with a duty cycle of less than 10% or greater than 90% will have large output errors.

To cure that problem, IC3 is included to divide down the pulses depending on the settings of S2. With S2 in the "Hz" position, the signal is divided by two and by 2048 in the "kHz" position. No matter how short or long the duty cycle is, the input waveform to IC4 is always a squarewave, allowing a pulse train of any duty cycle to be measured.

The full-scale range (50, 500, or 5000) is selected by S3; S2 selects whether the scale is in Hz or kHz. The output voltage from IC4 is directly applied to M1 for frequency display. With an internal series resistance of 500 ohms on M1, the 2.5-volt full-scale output from IC4 will be at the meter's limit; R9 protects M1 from excess current in case of overload.

The value of C6 is a compromise between response time and output ripple. On the lowest settings, you

PARTS LIST FOR THE FREQUENCY PROBE

SEMICONDUCTORS

IC1—LM311 comparator, integrated circuit (National Semiconductor)
IC2—78L05 low-power 5-volt regulator, integrated circuit
IC3—CD4040 12-stage binary counter, integrated circuit
IC4—LM2917 frequency-to-voltage converter, integrated circuit
D1—1N4148 silicon diode
D2—1N5711 Schottky diode

RESISTORS

(All resistors are 1/4-watt, 5% units, unless otherwise noted.)
R1—3900-ohm
R2—3300-ohm
R3, R5, R6—10,000-ohm
R4—1000-ohm
R7—150,000-ohm
R8—100,000-ohm potentiometer, single turn
R9—47-ohm

CAPACITORS

C1, C7—1-µF, 16-WVDC, solid tantalum, electrolytic
C2, C8—0.1-µF, ceramic-disc
C3—0.01-µF, polyester, 5%
C4—0.1-µF, polyester, 5%
C5—0.001-µF, polyester, 5%
C6—3.3-µF, 16-WVDC, solid tantalum, electrolytic
C9—10-µF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

B1—9-volt battery
J1—RCA phono jack, panel-mount
M1—Analog panel meter, 0–5 mA
S1—Single-pole, single-throw, switch
S2—Single pole, double-throw, toggle switch
S3—Single-pole, double-throw, center-off toggle switch
Enclosure, ground clip, battery clip, IC sockets, probe needle, wire, hardware, etc.

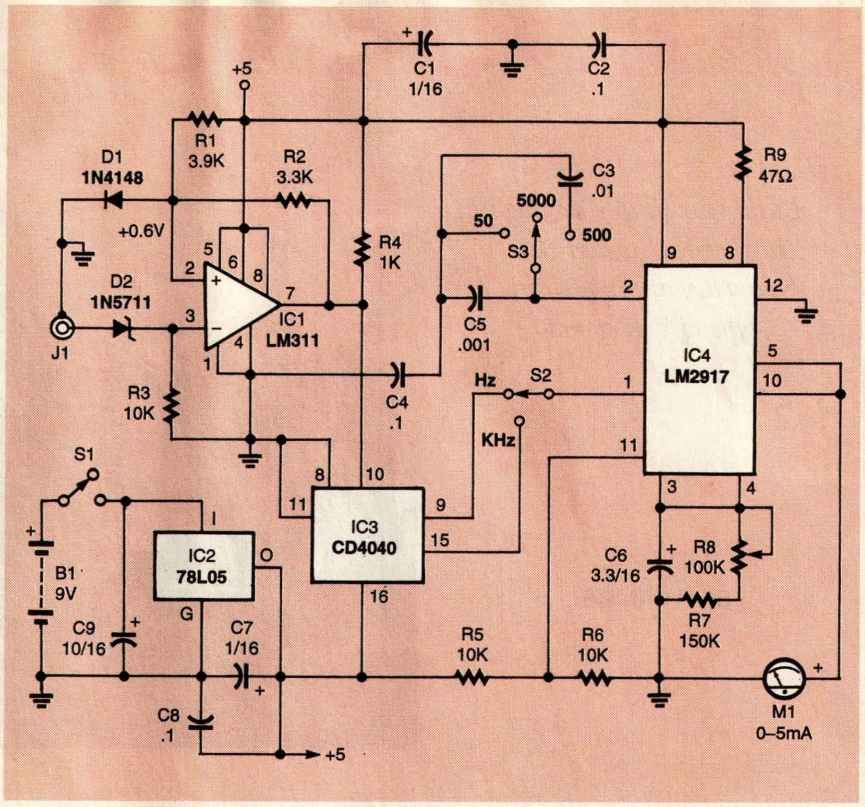


Fig. 1. The Frequency Probe changes any waveform to a squarewave and converts it to a current that is read out on a standard panel meter.

might see M1's needle vibrate slightly on readings below 5 Hz. If you want a more stable reading, you can increase C6's value for less ripple. Of course, that will increase the response and settling time of the Frequency Probe.

Calibration is set by R8, which alters the time constant of IC4's charge pump. The 2.4% error introduced by IC3 when in the "kHz" setting is just barely noticeable on the miniature 1-inch meter used for M1. To get the best overall accuracy, C3, C4, and C5 should be selected to match each other in exact decade multiples.

Construction Tips. Since the Frequency Probe is capable of measuring very high-speed input pulses, a compact and neat layout with short signal leads is not only recommended, but also almost mandatory. No foil pattern for an etched board is available; the Frequency Probe can be built on perfboard using standard construction techniques. To help you locate the components as close to each other as possible, Fig. 2 illustrates the component locations as used in the author's prototype. While you don't have to follow that suggested arrangement, it is known to give good performance.

Any probe-like enclosure that can hold all of the circuitry needed for the Frequency Probe can be used; just be sure that it is large enough. The internal arrangement of the author's prototype, shown in Fig. 3, uses a RadioShack 270-1804 project enclosure. It is a good idea to do all of the mechanical construction first before wiring the board. With the chassis laid out, it is much easier to locate and drill the mounting holes for the board before the components are installed and wired.

The probe needle itself is made from a 1/8-inch diameter piece of brass or steel rod that is 1 3/4-inch long. File one end to a point and round off the other end for easy insertion into J1. To do that quickly and easily, you can mount the rod in a power drill or lathe and grind it to shape. The finished probe tip should look like the one shown in Fig. 4.

Obviously, any signal being applied to the Frequency Probe must be referenced to the Frequency Probe's ground. A simple length of wire with a small alligator clip soldered to the end is connected to any convenient ground point on the Frequency Probe. A ground lug mounted in the case near J1 makes it easy to tie all of the ground wires together. You can attach the ground clip, the shield of J1, the negative side of B1, the negative lead of M1, and, of

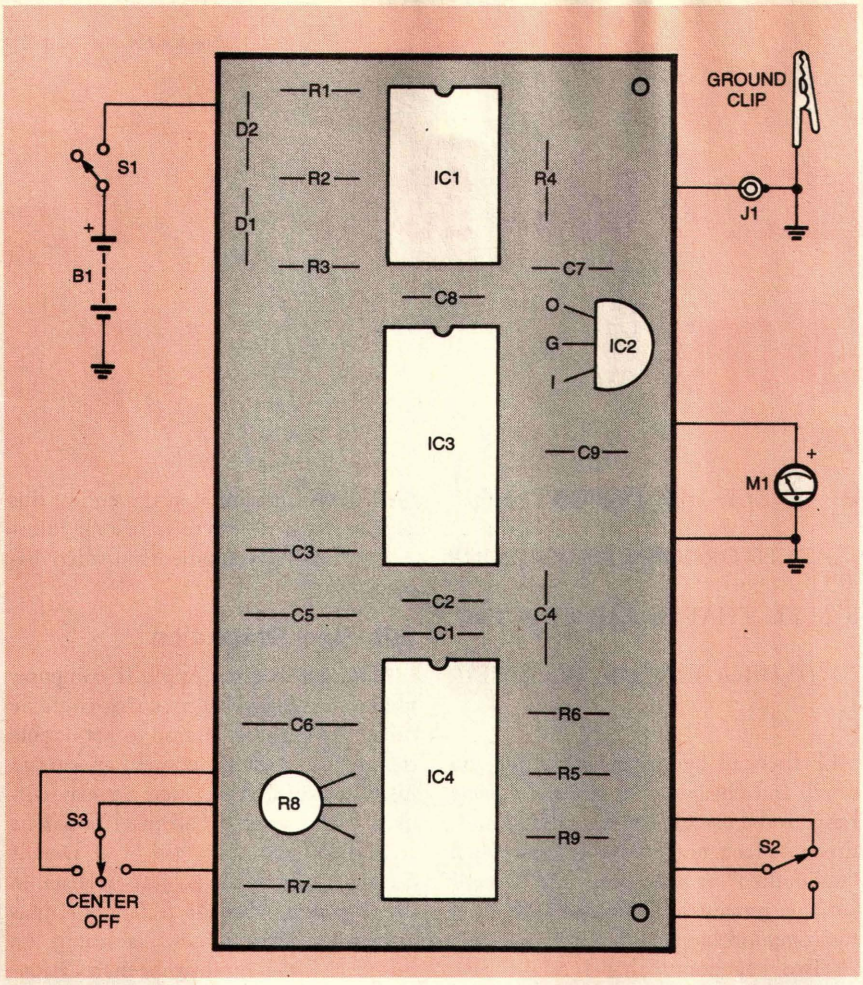


Fig. 2. While the Frequency Probe is a simple circuit, connections must be kept short. The author's perfboard layout shown here has resulted in a prototype that has a top end almost double the predicted results.

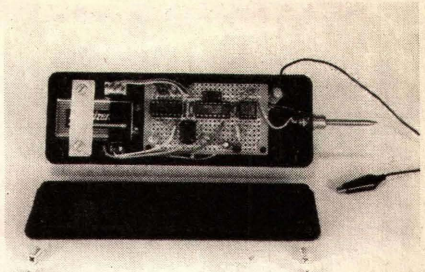


Fig. 3. With a properly-sized case, the Frequency Probe has a compact arrangement. Note how B1 is strapped down between two posts, S2, and S3. A ground lug near J1 makes a convenient point to tie all of the ground connections together—especially the external ground clip.

Fig. 4. A probe tip is easy to make by filing down a piece of 1/8-inch brass or steel rod. Rounding off the back end makes the probe needle easy to insert into J1. Not only does it fit securely into J1, it can be removed in order to make a direct cable connection to the Frequency Probe.

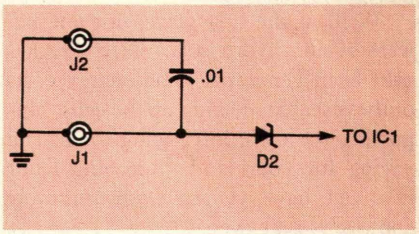


Fig. 5. By adding a second jack and capacitor, the Frequency Probe can sport an AC-coupled input as well as the standard input through J1.

course, the ground connection from the board to that lug.

Once the Frequency Probe is built, inspect your work carefully for any errors. With the probe tip inserted into J1 and a fresh 9-volt battery installed, you're ready to calibrate the unit.

Set Up and Calibration. With power turned on with S1, use a voltmeter to check for +5 volts at the output pin of IC2. If you do not get that reading, shut off the power immediately and correct the problem. If that reading is within 10%, check for +0.6 volts at pin 2 of IC1 and about +2.5 volts at pin 11 of IC4. If those voltages are also within about 10% or so, the Frequency Probe should work properly.

Set R8 at about mid-position and apply a known input frequency that is within the Frequency Probe's range to J1. The frequency should be suitable for displaying a reading of between 40–80% of full scale on M1; the signal should have an amplitude that is between 1.0 and 30 volts. If you want, you can remove the probe needle and apply the signal directly through a coaxial cable with an RCA-style phono plug.

Set S2 and S3 to accommodate the input frequency and adjust R8 so that M1 displays correctly. You might want to try a few different frequencies in different ranges for best overall accuracy. The absolute maximum input frequency that the Frequency Probe can handle depends on the waveshape and the input voltage, which affects the ultimate speed of IC1. You can expect a display of about 2 MHz before response falls off at higher frequencies. The author's prototype is able to function reliably at about double that frequency. Of course it goes without saying, "Your mileage may vary!"

The probe-needle/clip-lead input scheme works extremely well for most situations. If you need a direct cable input to J1, it is a simple matter to remove the probe needle and connect a length of coaxial cable (such as RG-58) with a shielded phono plug on the end. If your input signal is riding on a DC voltage outside of the triggering range (or over the maximum input voltage) of the Frequency Probe, use a 0.1-µF capacitor of suitable working voltage in series with J1. If you want, you can install a second phono jack next to J1 with that series capacitor installed in parallel with J1 for an optional "AC" coupled input. See Fig. 5. Ω

BY DON LANCASTER

Sub-Pixel Secrets, Diodes as RF Switches, and More

THERE SURE ARE SEVERAL LIVELY DISCUSSIONS NOW GOING ON IN THE SCI.ENERGY.HYDROGEN NEWSGROUP ON THE INTERNET. PROPONENTS FEEL THAT SOLAR ELECTRIC PANELS GENERATING COMPRESSED HYDROGEN GAS ARE THEIR way to go for "energy independent" personal vehicles. Sadly, they seem to positively refuse to look at all the fundamental numbers or even at the extensive work that has gone before, but accuse those trying to help of being "too negative" or "getting paid by the oil companies".

Well, in the first place, not one net watt of non-hydro solar electricity has ever been generated! The energy costs of the research, making up the cells, supporting the cells, interfacing them, and paying for your land, time, and labor involved have yet to even remotely approach break even.

The inherent low-efficiency limits of today's cells make hitting break even a daunting task. Only recently has the energy efficiency of cell manufacturing even been addressed. Thus, all of today's solar cells are paid for by oil or gasoline in disguise.

The magic break-even number is somewhere around a fully burdened eight cents per kilowatt hour. So far, solar electricity is far too valuable to waste on hydrogen apps. The energy in electricity is also of a much higher "quality" than in hydrogen because you can do more things with it and do so a lot more efficiently. Thus, changing from solar electric back to hydrogen can be a giant step in the wrong direction down the "energy" chain.

Further, there simply is not enough gross energy storage (3.5 watt hours per STP liter) in hydrogen gas to let you safely and cheaply gain enough vehicle range to be useful. You are talking hundreds of feet, not miles—at least when "unliquified" at sane pressures. Decent storage remains the crucially limiting hydrogen problem.

Two key points that I might have mentioned a time or two before: 1) An hour in the library (or on the Web) is worth a month of lab time. And 2) science works by standing on the shoulders of giants. So, ignoring what has gone before is sheer lunacy, especially in fields with hundreds of years of history.

Realistic personal transportation alternatives are now at www.rmi.org and maybe at www.homepower.com. More on hydrogen can be linked at my www.tinaja.com/h2gas01.html.

There is a very exciting new hydrogen storage development—one that just might make it all happen. We'll tell you where to find out more about it in our New Tech Lit section at the end of this article. But first, let's turn to some interesting "new" developments in video displays.

NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher AZ, 85552
Tel: 520-428-4073

US email: don@tinaja.com
Web page: http://www.tinaja.com

Sub-Pixel Resolution

The old original Apple II computer used a sneaky display trick that could be called sub-pixel resolution to get double the apparent screen content in certain hi-res modes. For instance, a green half-pixel and a purple half-pixel could be combined into a full white pixel. Details on this could be found way on back in my *Enhancing Your Apple II, Vol I*, plus numerous other places. Variations on this trick have recently been rediscovered and promise to very much improve the apparent small text legibility of both laptops and dynabooks. In fact, sub-pixel positioning just may be the "enabling technology" to finally blow traditional print media out of the water, especially when it is combined with other tricks.

Microsoft calls their "new" take on sub-pixel tricks ClearType. The critics promptly re-labeled it HypeType. But you are certain to see lots of variants coming up. Apple II pioneer Steve Gibson has his outstanding tutorial and sample Web site up on sub-pixel schemes at grc.com/cleartype.htm, including freebie interactive software demos you can explore for yourself and links to other sub-pixel sites.

One older way of improving your display resolution is by anti-aliasing. With anti-aliasing as it typically is done, you create a weighted average of adjacent pixels using a low-pass filtering process. Replacing all the blacks and whites with varying gray levels allows the text to be shown in a more pleasing manner. The artifacts created by a sampling are usually at rather high frequen-

new from
DON LANCASTER

ACTIVE FILTER COOKBOOK
The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. $28.50

RESEARCH INFOPACKS
Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See www.tinaja.com/info01 for specifics. $79.00

CMOS AND TTL COOKBOOKS
Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. $28.50 each.

INCREDIBLE SECRET MONEY MACHINE II
Updated 2nd edition of Don's classic on setting up your own technical or craft venture. $18.50

LANCASTER CLASSICS LIBRARY
Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. $119.50

LOTS OF OTHER GOODIES

Tech Musings V or VI	$24.50
Ask the Guru I or II or III	$24.50
Hardware Hacker II, III or IV	$24.50
Micro Cookbook I	$19.50
PostScript Beginner Stuff	$29.50
PostScript Show and Tell	$29.50
PostScript Video & secrets	$29.50
PostScript Reference II	$34.50
PostScript Tutorial/Cookbook	$22.50
PostScript by Example	$32.50
Understanding PS Programming	$29.50
PostScript: A Visual Approach	$22.50
PostScript Program Design	$24.50
Thinking in PostScript	$22.50
LaserWriter Reference	$19.50
Type 1 Font Format	$16.50
Acrobat Reference	$24.50
Whole works (all PostScript)	$380.00
Technical Insider Secrets	FREE

BOOK-ON-DEMAND PUB KIT
Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. $39.50

THE CASE AGAINST PATENTS
For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. 28.50

BLATANT OPPORTUNIST I
The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. $24.50

RESOURCE BIN I
A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. $24.50

FREE SAMPLES
Check Don's Guru's Lair at *http://www.tinaja.com* for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resouces, too. Tech help, hot links to cool sites, consultants. email: *don@tinaja.com*
FREE US VOICE HELPLINE VISA/MC

SYNERGETICS
Box 809-EN
Thatcher, AZ 85552
(520) 428-4073

FREE catalog: http://www.tinaja.com

When **ANTI-ALIASING**, each pixel gets replaced with a weighted average of adjacent bits according to a rule matrix such as...

1/18	2/18	1/18
2/18	6/18	2/18
1/18	2/18	1/18

Anti-aliasing works quite well to remove the "jaggies" out of graphics, but tends to blur and lighten smaller text. Anti-aliasing is easily done late in the display process and is largely independent of content.

When **GRAYSCALING**, each pixel gets replaced with the amount of gray that each individual pixel represents. Special and often custom bitmapped fonts are required for the obvious grayscaling benefits.

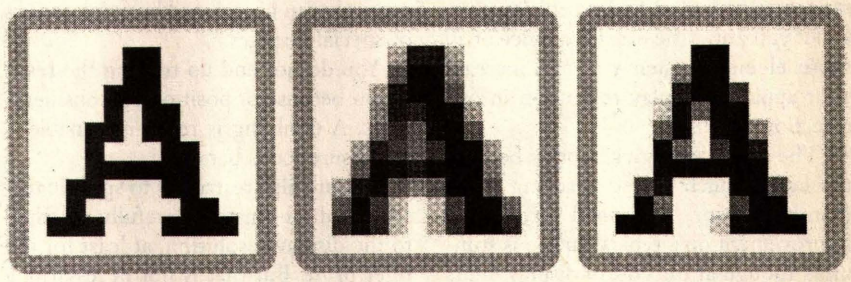


FIG. 1—ANTI-ALIASING AND GRAYSCALING are two older methods to improve small text appearance on most video displays.

cies. Spatial low-pass filtering thus favors the original content.

As Adobe Acrobat has shown us, an anti-aliasing often improves the legibility and appearance of smaller text, but often at the cost of getting somewhat gray and blurry. Figure 1 shows us the basics of anti-aliasing. In general, normal spatial low-pass anti-aliasing is great for taking the "jaggies" out of graphic images but only so-so and fuzzy for improving small text.

Grayscaling

There can be other sneaky ways to improve screen legibility. The main problem with anti-aliasing is that it is general spatial low-pass filtering after the fact. It's fast and cheap, but done late in the process, thus it always blurs and smears because no more information content is made available in the process.

But what happens if you instead match each pixel only to its wanted internal data beforehand—replacing each intended pixel with that fraction of gray (or other color) it is intended to optimally represent? Figure 1 also lets you compare that grayscaling alternative against bitmapping and after-the-fact low pass filter anti-aliasing. As you can see, the Palatino improvement at ten points is dramatic. But hand-crafted and bitmapped fonts are required for truly optimum results.

What got me started on this is that I was retouching a bitmap image for my new www.tinaja.com/barg01.html surplus bargain Web page and noted that the word PULL can be shown legibly with a 2×3 dot matrix! Start with an accurate character. To do grayscaling, optimally overlay the accurate character onto an n by m matrix. Calculate the exact energy in each matrix block. Replace that part of the character with the equivalent gray. Since the eye can resolve up to 64 bits of gray information, you are providing up to 64 times the information before quantizing into pixels. Your screen now has lots more information that it can work with.

Raw PostScript is amazingly adept at this sort of thing, especially its little known infill operator. The font capture and gray-scale coding can be automated, and this technique should work with most color combinations. Character sets will often have to be generated ahead of time to specific resolution sizes. One big advantage would be platform independence. This should work better with

fonts optimized for low resolution screens—such as Stone.

Apparently I am not the only one playing with pixels. One grayscaling variant is known as hand anti-aliased fonts. Demos are at www.airwindows.com/shareware/fonts/index.html. There somewhat oversized fonts are retouched and then downcoded into appropriate grays.

Sub-Pixel Secrets

The "new" sub-pixel scheme in Fig. 2 can end up quite simple. If you have a display in which you can individually and separately address single and sequential red, blue, and green elements, and if you know the exact sequence of all those elements, then you can increase your apparent display resolution in one direction.

The sub-pixel trick works because the eye is much better at seeing detail than it is color. The small text-quality improvement on a typical laptop is stunning, though at the cost of display limits and special drivers.

As you can clearly see, combining sub-pixel techniques with grayscaling is a potent combination. But there are lots of "gotchas" to be aware of.

The idea applies mainly to LCD displays. No way is yet known to use a stock CRT monitor, nor is one likely to be found. Why? because the electron beam usually addresses many phosphor dots at once, and the multiple blue dots are not particularly left or right of the other colors.

You have to know the exact LCD color stripe sequence and match your software to it. Most LCDs are now RGB, but a few are BGR.

The resolution improvement only works in one direction. You'll want this to be horizontal, because most character details, bolding, italics, and kerning are all horizontal sensitive.

Thus, you are currently limited to landscape displays—unless someone builds a portrait-specific triad-rotated LCD display. You are also mostly limited to black text on a white background. There could be some color fringing, but it is apparently not too bad and almost certainly can be reduced by sneaky tricks or special displays.

You do not end up tripling the resolution because of positioning considerations. A doubling is more reasonable—but it sure looks better.

You are also restricted to specific text sizes that all must be carefully matched to the display resolution, at least for the finer print. But that is not necessarily a serious problem in a book-viewer type of machine.

Some color fringing is created by sub-pixel techniques. On the left side of each black font character in RGB sequence, chances are that blue may be weak or missing, thus giving you a possible orange fringe. On the right side, chances are that red is weak or missing, giving you aqua. Such modest LCD sub-pixel color fringing can probably be minimized by going to special displays whose color sequence shifts by one pixel on each horizontal line. Sort of a triple "super-PAL" mono mode.

Adobe has been strangely silent so far, but we can expect sub-pixel plug-ins for their Acrobat products. There is also an obvious but very expensive solution of increasing the display resolution, but it makes the most sense to make each portion of every pixel count the utmost before you demand more of them.

The PostScript code used to create these demos is up on my Web site (www.tinaja.com) in MUSE141.PSL You could easily explore these concepts further on your own. Consulting and code services are also available. See www.tinaja.com/info01.html.

ULTRASONIC BOOKS

1996 IEEE International Ultrasonics Symposium (FEFCS IEEE)
Clinical Sonography: A Practical Guide (Roger Sanders)
Diagnostic Ultrasound (Stewart Bushong)
Fundamentals of Ultrasonic Nondestructive Eval... (L. Schmerr)
Handbook on the Ultrasonic Examination of Aus... (Am Weld Soc)
Micromachined Ultrasound Proximity Sensors (Mark Hornung)
Nondestructive and Ultrasonic Testing for Aircraft (FAA Staff)
Piezolectric Actuators and Ultrasonic Motors (Kenji Uchino)
Power Sonic and Ultrasonic Transducer Design (B. Hamonic)
Three-Dimensional Ultrasound (Thomas Nelson)
Transducers for Sonics and Ultrasonics (M. McCollum)
Ultrasonic Bioinstrumentation (Douglas Christensen)
Ultrasonic Communication by Animals (Gillian Sales)
Ultrasonic Instruments and Devices (R. Thurston)
Ultrasonic Liquid Atomization (Harvey Berger)
Ultrasonic Measurements for Process Controls (L. Lynnworth)
Ultrasonic Measurement Methods (R. Thurston)
Ultrasonic Methods of Non-Destructive Testing (J. Blitz)
Ultrasonic Motors: Theory and Applications (S. Ueha)
Ultrasonic Sensors for Chemical and Process... (R. Asher)
Ultrasonic Transducer Materials (Oskar Mattiat)
Ultrasound: Biological Effects and Potential... (A. Williams)

For more details, see www.tinaja.com/amlink01.html

With **SUBPIXEL** techniques, each individual red, green, or blue pixel sub element gets treated as an individually addressable and position sensitive entity. As you can see, the apparent resolution improvement is dramatic. Especially when combined with custom grayscaled fonts.

The concept works because the eye is much better at resolving brightness than color. Subpixel techniques apply mainly to landscape LCD displays used for laptops and dynabooks. Exact color sequence must be known and matched.

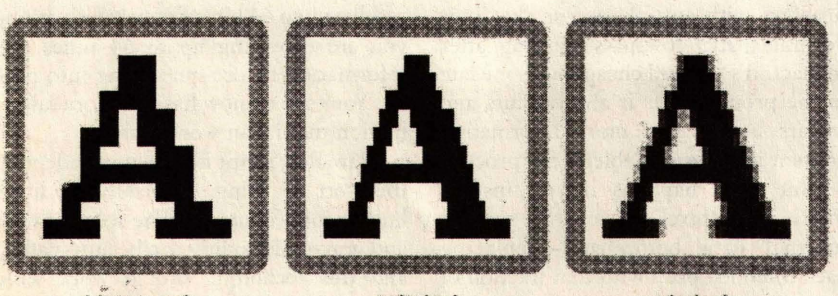


FIG. 2—"NEW" SUBPIXEL SCHEME promises to dramatically improve small text on certain LCD displays. Individually addressable color elements of a known sequence is required.

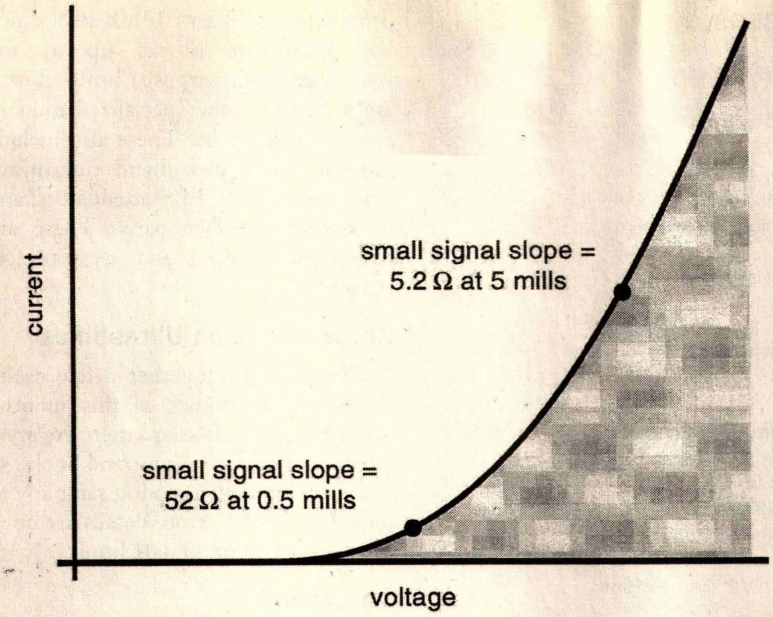


FIG. 3—ON ITS "KNEE", the slope of an ordinary diode is given by 26/i in milliamperes. Thus, a half mil DC current causes the diode to look like a 52-ohm resistor to very small RF signals.

Diodes as RF Switches

I've gotten several Help Line calls and e-mails on this topic, so it is time for an update and review. There's all sorts of times when you might like to turn a RF signal on or off, switch between two or more RF signals, activate a trap, change your channels or bands, or adjust RF-signal levels. These days, we have all sorts of options. Stock CMOS 4016 or 4066 analog switches can perform well at lower frequencies. Try my *CMOS Cookbook* or Maxim for details.

We also have new mid-frequency bus switch variations from Cypress, IDT, Pericom, Quality, and others. Get more info from www.questlink.com. Lots of ads for fancy and ready-to-go microwave switches and attenuators appear in trade journals such as *Wireless Product News*, *Wireless Design & Development*, *RF Design*, or *Microwaves & RF*.

But plain old diodes can also still be used here, as can their improved offspring. Figure 3 shows us the forward curve of an ordinary silicon diode such as a 1N914. Since this is a plot of current versus voltage, the slope at any point will also be the equivalent resistance. At one mil, the equivalent small-signal resistance of a silicon diode is roughly 26/i where i is the current in milliamperes.

Thus, any DC current of half a mil makes a diode look like a 52-ohm resistor to very small AC signals. The higher the current, the lower the apparent RF resistance.

The trick is to set up two paths: A signal path that accepts low-level RF signals and is capacitively coupled, and a DC-coupled bias path that turns the diode on or off. Resistors or inductors are used in the bias path to only lightly load the signal path. Capacitors block the bias currents in the signal path. The diodes are largely "off" with zero current, and they act as fixed resistors with carefully set bias currents of a few milliamperes.

These days, there's an even better device known as a PIN diode. PIN diodes are diodes that are purposely designed to have exceptionally long carrier lifetimes and slow reverse recovery times. As such, they make useful current-controlled resistors for VHF and microwave apps. They are low in cost, and the bias current sets the resistance down to a fraction of an ohm. But do observe that PIN diodes are largely useless below 10 megahertz.

As with a regular diode, you set up an AC RF path and a DC biasing path. If you are sneaky, the diode's package capacitance can be resonated out or included as part of a filter.

Useful devices include the 1N5719 and others from Hewlett-Packard, or the BA582, BAT18, and friends from Infineon (who apparently used to be Siemens). With the BAT18 device, RF resistance at five mils is less than half an ohm. Recovery time is 100 nanoseconds.

Once again, the intentionally long PIN effective carrier lifetime does not change much on a RF cycle, making for a seemingly constant controlled resistance at RF, which is what PIN diodes are all about. Diodes may be combined into "L," "P," or "T" arrangements for more loss or better impedance matching. A simplified schematic for a multiple PIN-diode P attenuator is shown in Fig. 4. When properly designed, P attenuators offer a constant input and output impedance.

Use of two pairs of symmetrical back-to-back diodes can reduce the non-

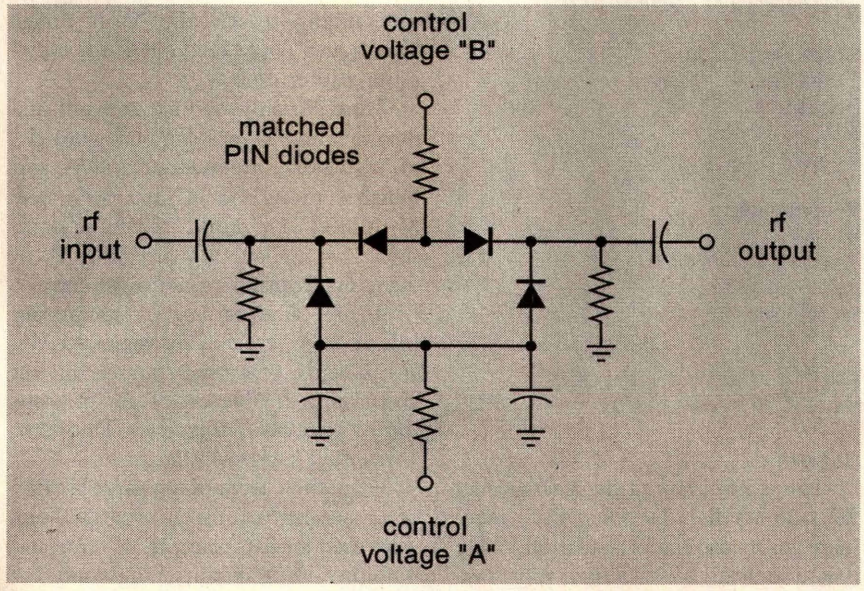


FIG. 4—SIMPLIFIED SCHEMATIC of a high-performance PIN-diode RF switch or attenuator. The P-network arrangement gives a constant input and output impedance. Control voltages must be carefully set for best results.

NAMES AND NUMBERS

AEMC Instruments
99 Chauncy St.
Boston, MA 02111
(800) 343-1391
www.aemc.com

Alpha Industries
20 Sylvan Road
Woburn, MA 01801
(781) 935-5150
www.alphaind.com

Cypress Semiconductor
3901 N First St.
San Jose, CA 95134
(408) 943-2600
www.cypress.com

Digital Content Creator
201 E Sandpoint Ave. Ste. 600
Santa Ana, CA 92707
(714) 513-8400
www.dccmag.com

Energy User News
1350 E Touhy Ave.
Des Plaines, IL 60018
(847) 390-2120
www.energyusernews.com

Hanser Gardner
6915 Valley Ave.
Cincinnati, OH 45244
(888) 527-8803
www.hansergardner.com

Hewlett-Packard
PO Box 10301
Palo Alto, CA 94303
(415) 857-1501
www.hp.com

IDT
2975 Stender Way
Santa Clara, CA 95054
(800) 345-7015
www.idt.com

Infineon Technologies
1730 North First St.
San Jose, CA 95112
(408) 501-6000
www.infineon.com

Maxim Integrated Products
120 San Gabriel Drive
Sunnyvale, CA 94086
(408) 737-7600
www.maxim-ic.com

Micro Plastics
Hwy 178 N
Flippin, AR 72634
(870) 453-2261
www.microplastics.com

JI Morris Co.
394 Elm St.
Southbridge, MA 01550
(508) 764-4394

Pericom Semiconductor
2380 Bering Drive
San Jose, CA 95131
(408) 435-1100
www.pericom.com

Pasternack Enterprises
PO Box 16759
Irvine, CA 92623
(949) 261-1920
www.pasternack.com

Pico Technology
149-151 St Neots Rd.
Hardwick, Cambridge CB3 7QJ, UK
44 (0) 1954 211716
www.picotech.com

Print On Demand Business
445 Broad Hollow Rd.
Melville, NY 11747
(800) 308-6397
www.podb.com

Quality Semiconductor
851 Martin Ave.
Santa Clara, CA 95050
(408) 450-8063
www.qualitysemi.com

Rohm Corporation
2150 Commerce Drive
San Jose, CA 95131
(408) 433-2225
www.rohm.com

Synergetics
Box 809
Thatcher, AZ 85552
(520) 428-4073
www.tinaja.com

linearity and distortion. Control voltages (and their diode currents) have to be carefully adjusted to work together to get the correct attenuation and impedance. The attenuation can range from very little loss up to 70 decibels. See the Alpha Industries application note *A Wideband General Purpose PIN Diode Attenuator*.

The same circuit makes a rather nice RF switch simply by going from minimum to maximum attenuation. Note that advanced construction and measurement skills are required for this simple and cheap circuit.

I have some great prices on digitally programmable 0.5 to 30 dB PIN diode RF atteunator blocks up at my www.tinaja.com/bargps01.html. These are a part of some specialized military *artery link* receivers. These also include multiple-stage broadband microwave amplifiers, analog PIN attenuators, and fiber-optic interface parts. These are real parts bonanzas and great project starters.

Some Books on Ultrasonics

I've gathered together a few useful books on ultrasonics as this month's resource sidebar. It seems there are great bunches of medical ultrasound books, so I've included only a modest sampling of these many titles. More details are up at www.tinaja.com/amlink01.html.

New Tech Lit

As promised at the beginning of this month's column, a major real-world breakthrough in hydrogen storage appears as "High H2 Uptake by Alkali-Doped Carbon Nanotubes under Ambient Temperature and Moderate Pressure" By Lin, Chen, Wu, and Ti in *Science*, Vol. 285, July 2, 1999, pages 91-93. The magazine's Web site is www.sciencemag.org. If you are not an AAS member, reprints are $5 per download. Or $10 for 24 hour guest access to their entire page full of reprints and abstracts.

Carbon nanotubes are very good at accepting and storing hydrogen. But keeping them stable and getting them to give most of their hydrogen back simply and safely have been huge problems. You might search the Web under "Rodriguez" and "Hydrogen" for interesting earlier work.

From Maxim, there's a new full-line data catalog CD on their analog switches, regulators, interface, A/D, D/A, and bunches more. Check out their new MAX1644 regulator. From Rohm, there's a similar CD on all sorts of intriguing consumer electronics chips.

A new line of current-measuring instruments is available from AEMC Instruments. One pricey source for just about any test cable, connector, or adaptor is Pasternack Enterprises. They have a free mini-catalog available.

From Pico Technology, there are free demos on virtual-instrumentation software used for data acquisition, temp and humidity, I/O conditioning, and for environmental monitoring.

Insider technical books on plastics

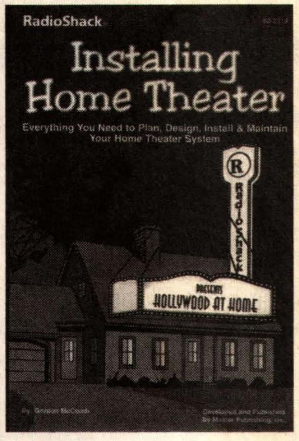
(Continued on page 97)

NEW LITERATURE

Installing Home Theater: The Complete Guide to Buying, Installing and Maintaining Home Theater Systems

by Gordon McComb
Master Publishing, Inc.
7101 N. Ridgeway Avenue
Lincolnwood, IL 60712
Tel: 847-763-0916
Web: www.masterpublishing.com
$6.99

This easy-to-read book provides a complete guide to understanding all aspects of home theater. It begins by defining home theater, describes the components needed, what components can be reused, what needs to be new, and what equipment is necessary. In addition, the author covers the differences among TV sets and AV receivers and the latest advances in TV sets, including the transition to digital TV and the wide-screen format.

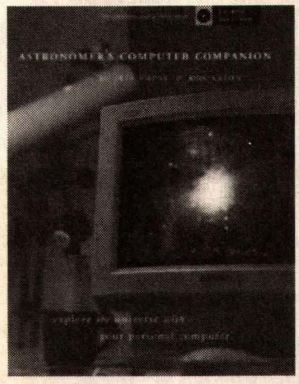

RadioShack
Installing
Home Theater
Everything You Need to Plan, Design, Install & Maintain Your Home Theater System
HOLLYWOOD AT HOME

The sound system required for a true theater-like experience in the home is thoroughly explained—speaker types, where they should be in the room, and AV receivers. There are also useful diagrams on hooking components together, wiring tips, suggestions for room design and ergonomics, and guidance on home-theater equipment maintenance. Several easy-to-use charts help readers troubleshoot common problems from no sound to interference from outside sources. This book (#62-2319) is available at RadioShack stores nationwide and in Canada.

Astronomer's Computer Companion

by Jeff Foust and Ron LaFon
No Starch Press
555 De Haro Street, Suite 250
San Francisco, CA 94107
Tel: 415-863-9900
Fax: 415-863-9950
Web: www.nostarch.com
$34.95

This first guide to locating and using astronomy resources on a personal computer introduces basic astronomy concepts. Simultaneously, it shows readers how to use computer-based resources to enhance their sky watching.



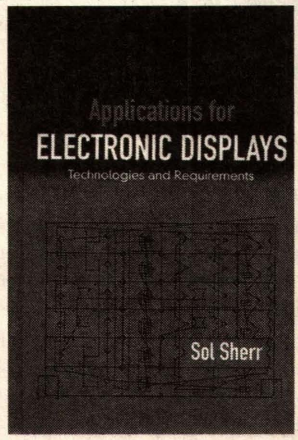
The authors sort through the "astronomical" number of Internet sites on the subject and present them in an organized and usable format. They discuss astronomy software and how to use it effectively. The book's included CD-ROM contains animations, shareware applications, astronomical images, plus a list of hardware and software resources and a list of Web sites for the amateur astronomer.

BooksNow To order books in this magazine or, any book in print. Please call anytime day or night: **(800) BOOKS-NOW (266-5766)** or (801) 261-1187 ask for ext. 1454 or visit on the web at **http://www.BooksNow.com/electronicsnow.htm.**
Free catalogs are *not* available.

Applications For Electronic Displays: Technologies and Requirements

by Sol Sherr
Wiley-Interscience
John Wiley & Sons
605 Third Avenue
New York, NY 10158
Tel: 212-850-6366
Web: www.wiley.com
$69.95

Emphasizing the options that are available for finding the best match between application requirements and display technologies, this resource provides invaluable information and guidance. It is designed for everyone from manufacturers and design engineers to technicians in the computer and entertainment industries.



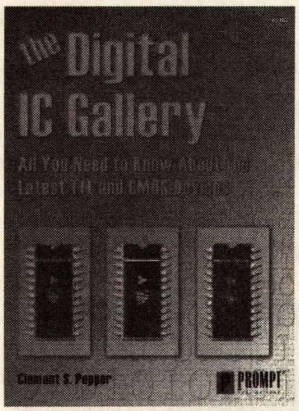
Key technical aspects are discussed. There is thorough coverage of display specifications; design, photometric, and visual parameters; and human-interface requirements. The author covers output devices and systems, including CRT and FPD monitors, hard-copy devices, and large-screen systems; and data-processing systems. In addition, he discusses computer graphics, CAD/CAE, multi-

media, virtual reality, and entertainment applications, among other topics.

The Digital IC Gallery

by Clement S. Pepper
Prompt Publications
Howard W. Sams & Company
2647 Waterfront Parkway, East Drive
Indianapolis, IN 46214-2041
Tel: 800-428-7267
Fax: 800-552-3910
Web: www.hwsams.com
$39.95

As an experimenter or hobbyist, it is difficult to discover the full range of devices appropriate for your intended application. Vendor catalogs often contain only a partial listing, and often only the best sellers are shown. However, with this book in hand, readers can identify digital devices in the TTL and CMOS logic families.

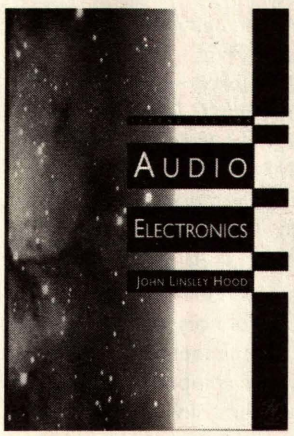


The author has compiled a comprehensive study of the latest semiconductors, complete with logic and connection diagrams, truth tables, functional descriptions, and performance data. Along with chapters on digital IC basics and gate logic, there's a glossary, as well as descriptions of the differing technologies used by various manufacturers. An appendix also lists numerous manufacturers' data books. If you work with or experiment with IC devices, this book will be very helpful on your workbench.

Audio Electronics

by John Linsley Hood
Newnes, Butterworth-Heinemann
225 Wildwood Avenue
Woburn, MA 01801
Tel: 800-366-2665 or 781-904-2500
Fax: 800-446-6250 or 781-904-2620
Web: www.bh.com/newnes
$39.95

Underlying audio techniques and equipment is a world of electronics that determines the quality of sound. Anyone involved in designing, adapting, and using digital and analog audio equipment needs an understanding of electronics for greater control over recorded or reproduced sound.

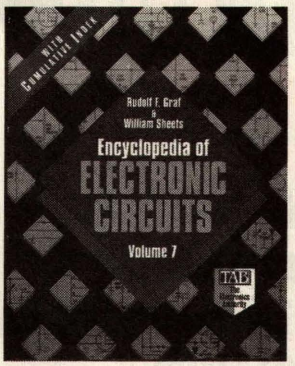


The second edition of this useful book includes new material in a wide-ranging survey of the field. The latest developments are covered: digital radio and TV, Nicam 728, and the latest Dolby noise-reduction systems. Numerous schematics and diagrams accompany the text.

Encyclopedia of Electronic Circuits, Volume 7

by Rudolph F. Graf and William Sheets
McGraw-Hill
1221 Avenue of the Americas
New York, NY 10020
Tel: 800-2MCGRAW
Web: www.book.mcgraw-hill.com.
$39.95

Designed for quick reference and on-the-job use, this encyclopedia presents over 1000 state-of-the art electronic and integrated-circuit designs. Organized alphabetically by circuit type, this all-new collection includes the latest designs from industry leaders such as Advanced Micro Devices, Motorola, Teledyne, General Electric, and others.

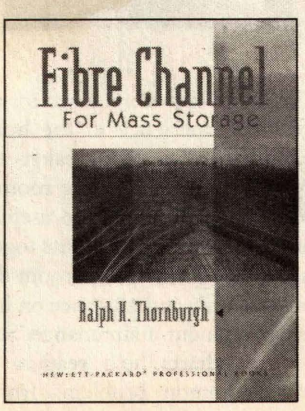


Each circuit is accompanied by a brief explanation of its operation and other information regarding adjustments or alignment. Included are diagrams and schematics for circuits used in power supplies, computers, and amplifiers, among others. An invaluable reference tool, this book also offers a cumulative index that covers all the circuits presented here and in each of the previous six volumes.

Fibre Channel for Mass Storage

Ralph H. Thornburgh
Prentice Hall
One Lake Street
Upper Saddle River, NJ 07458
Tel: 800-282-0693
Web: www.phptr.com
$45

Mastering Fibre Channel enables users to scale storage systems from gigabytes to terabytes and to improve perfor-



BooksNow To order books in this magazine or, any book in print. Please call anytime day or night: **(800) BOOKS-NOW (266-5766)** or (801) 261-1187 ask for ext. 1454 or visit on the web at **http://www.BooksNow.com/electronicsnow.htm**.
Free catalogs are *not* available.

BooksNow To order books in this magazine or, any book in print. Please call anytime day or night: **(800) BOOKS-NOW (266-5766)** or (801) 261-1187 ask for ext. 1454 or visit on the web at **http://www.BooksNow.com/electronicsnow.htm.**
Free catalogs are *not* available.

mance simultaneously—all without disrupting systems or networks. This Hewlett-Packard (H-P) Professional Book (Web: www.hp.com/go/retailbooks) walks readers step-by-step through the basics of this next-generation technology and demonstrates how to deploy H-P's advanced Fibre Channel products to solve enterprise storage problems.

The author introduces H-P's state-of-the-art Fibre Channel product family, beginning with Tachyon, the industry's first Fibre Channel controller fully integrated on a single chip. H-P's adapters for K-, T-, D- and V-Class Enterprise Servers and parallel clusters; hubs; disk arrays; SCSI multiplexers; and more are thoroughly covered. There is also a preview of the future of Fibre Channel faster fiber rates, hunt groups, multicast groups, and classes of service. EN

TECH MUSINGS

(continued from page 94)

are published by the Hanser Gardner folks. Ultra-small nuts, screws, taps and dies can be found at J. I. Morris. Almost any variety of plastic fastener is sold by Micro Plastics.

Our featured trade journals for this month are *Digital Content Creator*, *Print on Demand Business*, and *Energy User News*.

For most individuals most of the time, any involvement with patents is virtually certain to end up as a net loss of your time, energy, money, and sanity. Find out why along with lots of proven real-world alternatives in my *Case Against Patents* package per www.tinaja.com/synlib01.html or my nearby Synergetics ad. Also check into my new Webmastering Secrets and similar InfoPacks.

Latest Web-site additions now up at www.tinaja.com include scads of GPS and navigation stuff, columns on new antenna resources, and more great surplus bargains. Besides great techie items, you will find everything from Micronesian flags to water-soluble swimsuits to Y2K wilderness survival land to Kinetron II medieval torture chambers to germ warfare kits. There are online auctions, too.

As usual, most of the referenced items are in our Names and Numbers or Ultrasonic Books sidebars. Always check those first before you call our no-charge US help line or e-mail me at don@tinaja.com as per the nearby box. Let's hear from you. EN

EQUIPMENT REPORT

(continued from page 4)

as is software for downloading images from the camera. All software supports both Windows and Macintosh computers.

This impressive list of features is packed into a digital camera that has a film-camera-like look and feel, with dimensions of 4.2 inches wide by 2.9 inches high by 2.6 inches deep and a weight of only 10.7 ounces. The C-2000 Zoom has a street price of $999, and lower.

P-330 Photo Printer

One of the nicest things about all Olympus digital cameras, including the C-2000 Zoom, is that they can print directly to the Olympus P-330 photo printer. Olympus' first-generation photo printer, the P-300, could connect directly to most Olympus digital cameras, without needing a computer, and print glossy 4- × 5.5-inch photos with the touch of a single button. The printer could also be connected to the parallel port on a PC to make prints from any digital images, including Internet downloads and images edited on a computer. The quality of the prints rivaled 35mm prints. The latest photo printer from Olympus, the P-330, produces the same great prints as the P-300, but with far greater flexibility.

The P-330 is a dye-sublimation printer that makes 4- × 5.5-inch prints only, in 24-bit color (16.7 million colors) at a rate of about 2 minutes per page. It can print up to 30 copies of a single image at once or print up to 16 thumbnails on a single sheet. The printer uses special ribbon cartridges and glossy printing sheets that come 60 to a pack along with a new ribbon cartridge for about $40, making these prints cheaper than Polaroids—and the quality is better, especially when you're printing the 2.1-megapixel source images provided by the C-2000 Zoom.

Like the P-300, the P-330 can print directly from Olympus digital cameras and from PCs through the parallel port and Macs through the serial port. But the P-330 photo printer also has a video output so that it can be connected to a TV set and a slot that accepts SmartMedia cards.

Now there is no need even to connect the camera to the printer, thus avoiding cables altogether. One simply removes the SmartMedia card from the camera and slips it into the P-330. Images are then reviewed on the TV screen and printed by pressing a button on the P-330. Images stored on a SmartMedia card can also be "dog-eared" while still in the camera, so that they will print on the P-330 without the user having to connect the printer to a TV set or needing to see them at all.

The P-330 printer is also a SmartMedia card reader, allowing images or other data stored on SmartMedia cards to be transferred to a PC via the parallel port, but only for Windows users. Another neat feature of the P-330 is that it has a video input. With the printer connected to a TV set, any frame from the incoming video signal can be grabbed and printed. This allows still prints to be made from videotape, a video camera, DVD or whatever. The P-330 costs $449.

For more information on the Olympus C-2000 Zoom digital camera or the P-330 digital printer, contact the manufacturer, Olympus America, Digital & Imaging Systems Group (Two Corporate Center Dr., Melville, NY 11747-3157; Tel: 516-844-5000 or 800-347-4027; Fax: 516-844-5262; Web: www.olympus.com/digital) directly or circle 15 on the Free Information Card. EN

ECL/TTL/PECL
INSTRUMENT-LIKE FUNCTIONS
@
COMPONENT-LIKE PRICES
www.pulseresearchlab.com/products/blt/default.htm

Don't lose sight of Glaucoma.
NATIONAL EYE HEALTH EDUCATION PROGRAM

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number		Page
–	Abacom Technology	58
–	ABC Electronics	74
213	Alfa Electronics	58
214	All Electronics	79
–	Allison Technology	54
–	Amazon Electronics	76
–	Andromeda Research	78
–	Antique Radio Classified	52
–	Arrow Technologies	52
–	Brand Electronics	60
–	Bsoft Software, Inc.	83
322	C&S Sales, Inc.	62
133	CircuitMaker	CV2
332	Circuit Specialists	59
–	CLAGGK, Inc.	3, 25, 32, 46
–	Cleveland Inst. of Electronics	35
–	Command Productions	54
–	Computer Monitor Maintenance	66
–	Connecticut microComputer	71
–	Conitec	12
58	Cooks Institute	6
234	Dalbani	67
–	EDE Spy Oultet	77
241	Electronic Goldmine	57
–	Electronic Tech. Today	82
–	Emac Inc.	70
–	Engineering Express	76
335	Foley-Belsaw	72
–	General Device Instruments	77
–	Grantham College of Eng.	6
329	Graymark	56
–	Great Southern Security	65
–	Home Automation	71
331	Howard Electronics	81
–	Howard Electronics	52
–	Information Unlimited	56
–	Intec Automation	77
–	Intelligence I^2 Inc.	77
–	Intelligent Products	76
138	Interactive Image Technologies	CV4
–	Intronics	71
319	IVEX Design	69
–	J&M Microtek, Inc.	76
–	Keware Technologies	74
–	KNS Instruments	60
–	Lynxmotion	74
–	M^2L Electronics	60
327	MCM electronics	CV3
251	Mendelsons	66
306	Merrimack Valley Systems	70
236	Micro 2000	53
–	microEngineering Labs	52
–	Modern Electronics	66
–	Mondo-tronics	66
318	Mouser Electronics	52
–	MSC Electronics	77
–	NESDA	23
–	PC Boards	58
–	Pioneer Hill Software	71
222	Polaris Industries	68
315	Prairie Digital	74
264	Print (Pace)	75
266	Ramsey Electronics	61
283	Resources Unlimited	73
334	RobotikitsDirect	51
–	Saelig Co. LLC	78
–	Securetek	76
–	Sil Walker	60
–	Square 1 Electronics	83
–	Super Circuits	60
–	Techniks	76
–	Technological Arts	80
312	Telulex	64
333	Test Equipment Depot	80
275	Timeline	83
–	Unbound	70
282	Velleman	55
310	Visitect Inc.	64
170	Wavetek Corp.	21
–	Weeder Technologies	78
–	World Star Technologies	77
–	World Wyde	76, 77
–	XX Box	26
–	Zagros Robotics	52
–	Zorin	76

ADVERTISING SALES OFFICES

Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735-3931
Tel. 516-293-3000
Fax: 516-293-3115

Larry Steckler
Publisher (ext. 201)
e-mail: advertising@gernsback.com

Adria Coren
Vice President (ext. 208)

Ken Coren
Vice-President (ext. 267)

Marie Falcon
Advertising Director (ext. 206)

Adria Coren
Credit Manager (ext. 208)

For Advertising ONLY
EAST/SOUTHEAST

Megan Mitchell
9072 Lawton Pine Avenue
Las Vegas, NV 89129-7044
Tel. 702-240-0184
Fax: 702-838-6924
e-mail: mmitchell@gernsback.com

MIDWEST/Texas/Arkansas/
Oklahoma

Ralph Bergen
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
Tel. 847-559-0555
Fax: 847-559-0562
e-mail: bergenrj@aol.com

PACIFIC COAST

Anita Bartman
Hutch Looney & Assoc., Inc.
6310 San Vicente Blvd. Suite 360
Los Angeles, CA 90048-5426
Tel. 323-931-3444 (ext. 227)
Fax: 323-931-7309
e-mail: anita@hlooney.com

Electronic Shopper
Joe Shere
National Representative
P.O. Box 169
Idyllwild, CA 92549-0169
Tel. 909-659-9743
Fax: 909-659-2469
email: joe@greencafe.com

Megan Mitchell
National Representative
9072 Lawton Pine Avenue
Las Vegas, NV 89129-7044
Tel. 702-240-0184
Fax: 702-838-6924
email: mmitchell@gernsback.com

Customer Service
1-800-999-7139
7:00 AM - 6:00 PM M-F MST

MCM ELECTRONICS®

The Source For All Of Your Electronics Needs

When ordering, please provide this code: ▶ SOURCE CODE: ENS64

Prices effective Oct. 5, through Nov. 30, 1999

For over 20 years, MCM has been the leading supplier to the electronics service industry. Huge inventory, rapid delivery and competitive prices have made MCM the choice for:

- Hobbyists
- Service Technicians
- Educators
- Installers

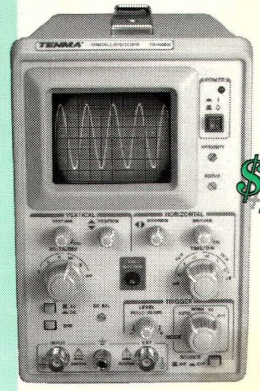
Discover the MCM difference, call today for your free literature.

ONLY $79.95

Order #21-1590

TENMA® Soldering Station

•Perfect for all types of board level and precision work •Digital LED display shows temperature and setpoint •Stand has tray for included cleaning sponge
•**Regular price $119.00**



ONLY $249

Order #72-6602

TENMA® 10MHz Oscilloscope

•Ideal for the student or hobbyist •Norm, auto, TV, sync and external triggering
•Operates on 115/230VAC, 50/60Hz
•Includes test lead

ONLY $70.00

Order #82-3890

DEFENDER SECURITY CCD Black and White Camera

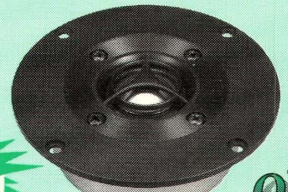
•Ultra compact, measures only 1½" square •⅓" image device •430 line resolution •3.6mm lens, 92° viewing angle •Requires only 12VDC, 100mA •Standard NTSC composite video output
•**Regular price $79.95**

ONLY $19.95

Order #72-4040

TENMA® Pocket DMM

•Perfect for field use •3½ digit, 3200 count display •Analog bar graph •AC/DC voltage to 450V •Resistance to 30Mohm •Measures only 2¼" (W) x ¾" (H) x 4¼" (L)
•**Regular price $25.25**



Order #53-571

ONLY $9.75

DYNAVOX® Shielded Titanium Tweeter

•Great for home theater and multimedia applications •1" voice coil •50W/100W RMS/max power capacity •1.5KHz~20KHz response •SPL 94dB 1W/1M •8ohm
•**Regular price $17.95**

Order #28-6402

ONLY $7.50

Audio Amplifier Module

•Great for a variety of hobby, service and prototype applications •Fully potted plastic enclosure •Accepts line level input (80mV) •12W RMS output @ 4ohm
•Operates on 6~16VDC, 800mA
•Dimensions: 2½" (W) x 1½" (D) x 1" (H)
•**Regular price $9.39**

Order #21-4230

ONLY $14.00

AKRO-MILS Tote Container with Lid

•Industrial grade •Stackable construction •Steel pin hinge •Provisions for using a padlock •Dimensions: 21½" (W) x 15" (D) x 17" (H) •Gray color
•**Regular price $17.95**

Order #55-1855

ONLY $8.90

MCM AUDIO SELECT™ Shielded 5" Woofer

•Great for home theater and multimedia applications •Aluminum cone •Rubber surround •11.6 oz. magnet •1" voice coil •50W/100W RMS/max power capacity •45Hz~15KHz response •SPL 87dB 1W/1M •Fs 45Hz •8ohm
•**Regular price $13.50**

FREE Literature!

1-800-543-4330

Secured Ordering at: www.mcmelectronics.com

Hours: M~F 7 a.m.~9 p.m., Sat. 9 a.m.~6 p.m., EST.

Same Day Shipping!
In stock orders received by 5:00 p.m. (YOUR TIME), are shipped the same day.

MCM ELECTRONICS®
650 CONGRESS PARK DR.
CENTERVILLE, OH 45459
*A **PREMIER FARNELL** Company*

SOURCE CODE: ENS64

CIRCLE 327 ON FREE INFORMATION CARD

The world's most popular simulator just got better.

MULTISIM SCHEMATIC CAPTURE AND SIMULATION

Flexible Symbol Editor NEW
To add or modify symbols for any component.

Power Meter NEW
Works just like with a real Wattmeter.

1000 New Components NEW
New families include Electromechanical, Connector, Wideband Opamp, and Tiny Logic.

Editable Footprint Field NEW
Add or change default footprint values directly from the schematic.

New Analyses NEW
AC sensitivity and DC sensitivity help determine the stability of your design.

Multiple Instruments NEW
Now you can have more than one copy of an instrument on the screen at once.

Enhanced Wiring NEW
Improved connections to pins and more intelligent autowiring.

Analysis Wizards NEW
Guide you through an analysis, making it easier than ever to take advantage of these powerful functions.

Virtual Instruments
Includes oscilloscope, function generator, multimeter, bode plotter, word generator, and logic analyzer.

9 Powerful Analyses
To analyze circuits in ways just not possible with real instruments. Includes DC, & AC operating point, transient, fourier, noise, DC sweep and Ac & DC sensitivity.

5,000 Components
Wide selection of commonly used components, all complete with simulation, symbol and footprint information.

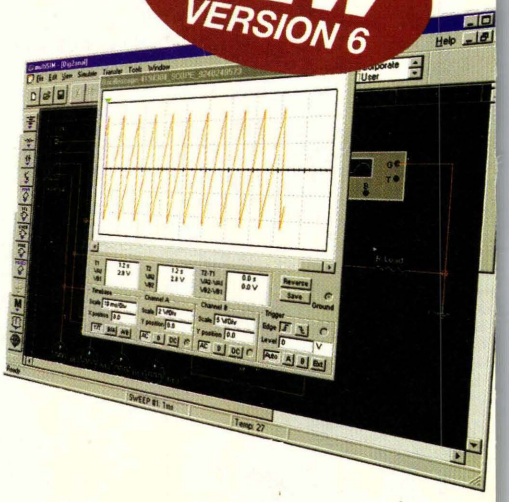
Full-Featured Schematic Capture
Industry's easiest-to-use design entry is ideal for generating high-quality schematics.

Changes on the Fly
The world's only simulator that lets you tweak your circuit during simulation for instant feedback.

Analog and Digital SPICE Simulation
Fast, accurate SPICE simulation with no limit on circuit size.

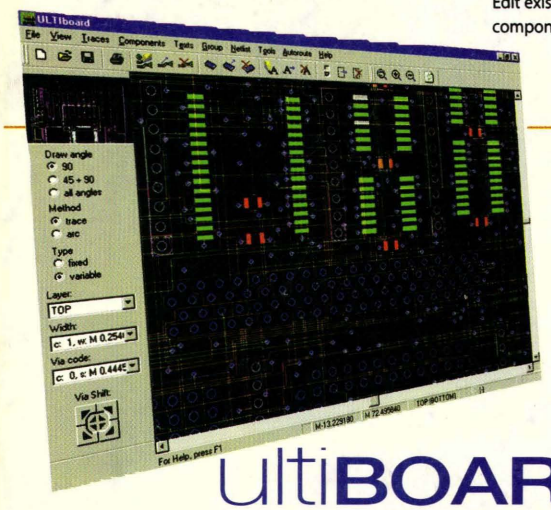
Custom Model Support
Edit existing models to create new parts, or import components as SPICE models from vendors.

NEW VERSION 6



multiSIM $399

Call for upgrade pricing



ultiBOARD $399

ULTIBOARD POWERFUL PCB LAYOUT

Fast Autorouting Multi-layer autorouter with configurable options for customized performance.

Real-Time DRC Automatic Design Rule Check prevents costly errors by monitoring the size and clearance of pads, vias and traces.

Ideal for all Boards Built-in board editor to create any shape board up to 50" X 50" in size, with as many as 32 layers.

Multiple Output Formats Outputs to the formats you need including Gerber, DXF, plotters, printers, and more.

Tight Integration with Multisim Supports forward and back annotation with Multisim, so that the programs share important design information.

Flexible Editing Full support of power and ground planes, with or without thermal relief. 'Reroute while move' to move copper without losing connectivity.

For a **FREE** demo visit www.**electronicsworkbench**.com

TO ORDER

SAVE $100.00

Call **1-800-263-5552**

Save $100 when you order the Personal Design Solution
(Includes Multisim and Ultiboard).

Electronics WORKBENCH

DESIGN SOLUTIONS FOR EVERY DESKTOP

CIRCLE 138 ON FREE INFORMATION CARD